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ABSTRACT

This report summarizes activities and findings of a federally funded center at the Research Triangle Institute (North Carolina) reviewing current knowledge concerning nonpharmacological interventions for improving educational outcomes for students with attention deficit disorders (ADD). For each of the seven topics reviewed, the report provides a synopsis summarizing the findings across studies; suggestions for educators; areas for further study; and a matrix of representative studies, displaying key variables and outlining findings most relevant to educators. The topics are: (1) positive reinforcement or token reinforcement; (2) behavior reduction strategies; (3) response cost; (4) self-instruction or cognitive behavioral training; (5) parent or family training; (6) task or environmental stimulation; and (7) biofeedback. An annotated bibliography provides bibliographic information and abstracts for 83 studies which represent the range of research and are particularly well designed or have special relevance for educators. The abstracts describe settings, subjects, and procedures; review the findings with an emphasis on those relevant to teaching and learning; and report conclusions. (Also contains an additional bibliography of approximately 150 items.) (DB)

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RESEARCH SYNTHESIS ON EDUCATION INTERVENTIONS FOR STUDENTS WITH ATTENTION DEFICIT DISORDER

Education of Children with Attention Deficit Disorder

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RESEARCH SYNTHESIS ON EDUCATION INTERVENTIONS FOR STUDENTS WITH ATTENTION DEFICIT DISORDER

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RESEARCH SYNTHESIS ON EDUCATION INTERVENTIONS FOR STUDENTS WITH ADD

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INTRODUCTION

With funding from the U.S. Department of Education's Office of Special Education Programs, RTI established a Center for Organizing and Analyzing the Research Knowledge Base for Children with Attention Deficit Disorder. One of four funded Centers, the RTI Center focused on non-pharmacological interventions for improving educational outcomes for students with attention deficit disorders (ADD). In this report[1], we summarize the findings from our review of empirical studies as a first step toward developing products that will be useful to specific target audiences, including practicing educators, researchers, and parents.

In creating this document, we identified, summarized, and synthesized the scientifically validated knowledge that has practical application in schools. Specifically, we searched and organized the ADD-related research on behavior management, academic instruction, home-school collaboration, and comprehensive educational programming. The studies we encountered, however, were limited in scope. They focused primarily on behavior management and self-control, much less on academic instruction and home-school collaboration, and not at all on placement decisions or curriculum issues. As such, the knowledge base contains serious gaps, particularly in the realms of instructional and curricular strategies and their influence on the academic performance of students with ADD in classroom settings.

The narrow focus of ADD-related research is just one of the shortcomings of the knowledge base related to education interventions for students with ADD. Most studies have been conducted by psychologists and physicians in laboratory or clinic settings, requiring caution in generalizing results and recommendations to education settings. Research subjects have been primarily 7- to 11-year-old boys, restricting the extent to which the findings can be viewed as applicable to the full range of students. Subject heterogeneity also limits generalizability as well as the legitimacy of comparisons across studies. The evolving definition of ADD, the use of screening instruments alone to identify research subjects, and the identification of ADD subjects by virtue of only one characteristic have all contributed to this heterogeneity. Most significantly, the criteria used for ADD diagnosis and subject selection have changed substantially over the past 15 years. Prior to 1980, researchers often selected subjects with ADD solely on the basis of hyperactivity, which we now view as just one characteristic of ADD. Much early research with these subjects then is relevant only to students with hyperactivity, who may or may not have ADD.

Overall, the findings from our work indicate areas deserving further investigation by researchers and special consideration by practitioners striving to develop empirically supported education programs for students with ADD. Because of the limitations in the research, however, we must be tentative in formulating conclusions and recommendations

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[1] We thank Ronald Reeve, University of Virginia, and Gary Stoner, University of Oregon, for their thorough reviews of the preliminary draft and valuable suggestions for this final product.

derived from the knowledge base. We cannot make definitive, categorical recommendations about educational programming. Rather, we can suggest promising classroom interventions, especially those based on behavioral strategies and the manipulation of instructional stimuli. For educators wishing to explore these promising interventions, we have prepared suggestions based on the available knowledge. We view the intervention suggestions in this document as starting points for developing effective education programs. We stress that, given the preliminary nature of the knowledge base related to the education of students with ADD, practitioners should *closely monitor* and *regularly evaluate* intervention effects to determine necessary modifications based on the responses of *individual students*.

LITERATURE SEARCH AND SYNTHESIS PROCEDURES

To derive information useful to educators, we systematically identified, reviewed, and synthesized the research literature on non-pharmacological interventions for children and youth with ADD. In the sections below, we outline the procedures we followed.

Identification of Studies

We conducted a search of the literature through an iterative process designed to identify work of historical significance as well as ongoing projects. Our search included the following activities:

- Computer searches of data bases in education, psychology, and medicine (ERIC, PsychINFO, and MedLine). Keywords included the following: attention deficit, hyperactive, hyperactivity, hyperkinesis, hyperkinetic, school, education, intervention, treatment, and review.

- Requests to organizations with a stake in services for students with ADD for intervention materials and reference lists.

- Pursuit of reference trails from research articles, review articles, and book chapters.

- Letters to leading researchers asking them to identify significant prior work, current ADD projects, and unpublished manuscripts, theses, or dissertations. (We defined "leading researchers" as researchers with at least three published research articles related to educational interventions for students with ADD--identified through our initial computer searches, pursuit of reference trails, and inquiries to ADD organizations--or researchers with fewer published works that were particularly relevant to our topic.

Development of Data Base

For inclusion in an electronic data base, we selected studies that met the following criteria: (a) empirically based, (b) some or all subjects with ADD (broadly defined to include subjects with ADD characteristics as well as subjects with specific diagnoses[2]), (c) intervention applicable to education settings or useful to practitioners designing interventions for education settings, (d) recent (or historically important), and

[2]Specific diagnoses and characteristics that met our criteria included the following: ADD (as an educational diagnosis), hyperkinetic reaction of childhood to ADD (DSM II), ADD with hyperactivity (DSM III), ADD without hyperactivity (DSM III), ADHD (DSM III-R), Undifferentiated ADD (DSM III-R), hyperactivity, overactivity, hyperkinesis, inattention, and impulsivity (if accompanied by other ADD characteristics).

(e) methodologically sound[3]. We did not include studies that examined only medication effects, but we did include research that compared drug therapies to other interventions. Applying these multiple criteria, we identified 150 studies and entered key study characteristics into the data base. These study characteristics included features relevant to our subsequent analysis such as study setting, sample size, subject characteristics, research design, intervener, independent variables, dependent variables, outcome measures, and statistical treatment.

Preparation of Annotated Bibliography

For annotation, we selected 83 studies from the data base that represented the range of research to date, were particularly well designed, or had special relevance for educators. In annotating the studies, we described settings, subjects, and procedures; reviewed the findings with an emphasis on those relevant to teaching and learning; and reported conclusions.

Synthesis

Although critical issues identified by parents, educators, and researchers guided our initial literature searches, the availability of data ultimately determined the organization of our synthesis. We sorted the studies by independent variables and explored various topical clusters. (Although researchers have studied a broad array of non-pharmacological interventions, in determining topics we considered only those interventions with sufficient data to indicate their effectiveness.) We settled on seven educationally relevant topics that had been addressed in some depth by research, grouping studies into the following intervention categories: positive reinforcement, behavior reduction, response cost, self-instruction or cognitive-behavioral training, parent or family training, task or environmental stimulation, and biofeedback.

Our initial intention was to analyze data across studies by comparing effect sizes. We decided against this quantitative meta-analytic strategy because of the great variation in treatments and outcome measures, the frequency of multicomponent treatments that make outcome attribution infeasible, the variability of settings, and the lack of subject homogeneity. Quantitative comparisons across studies with dissimilar features would have led to conclusions grounded in erroneous generalizations. By pursuing a qualitative analysis we were able to consider the diversity that characterizes the ADD intervention knowledge base, taking into account subtle but important differences among studies. Specifically, we examined trends over time, explored contradictions, and considered the limitations of individual studies. We attended especially to study design, giving greater weight, for example, to studies (a) using random assignment with no-treatment controls, (b) employing well-designed and replicable interventions, (c) set in general or special education classrooms,

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[3]In determining methodological soundness we considered (1) authenticity of research designs, (2) extent of control for effects of extraneous variables (including randomization of subject selection and treatment assignment when appropriate), (3) appropriateness of statistical procedures, (4) reliability and validity of outcome measures, and (5) use of ethical procedures.

and (d) using teachers or parents as the interveners. For the topical areas with sufficient data, we determined consensus findings, and we noted areas requiring further study.

TOPICAL SYNTHESES

In the following pages, we present a topical synthesis for each of the seven identified categories that includes (a) a *Synopsis* summarizing the findings across studies; (b) *Suggestions for Educators*, providing preliminary suggestions for practice grounded in the research; (c) *Areas for Further Study*; and (d) a *Matrix* of representative studies, displaying key variables and outlining findings most relevant to educators.

The narrative summaries and the matrices provide an overview of the research to date, not a comprehensive treatment of the topics. We have used this format because it provides a succinct guide for persons planning interventions or conducting additional research. We have stated the findings and suggestions briefly and with qualifying language for three related reasons. First, the current state of empirical knowledge on education interventions does not justify definitive, unequivocal statements. Instead, it calls for thoughtful consideration of often contradictory information that remains open to interpretation. Second, we view our conclusions and suggestions as starting points for those interested in developing effective education programs, and we hope that interested individuals will explore the issues further by referring to the annotated bibliography and to the original research. Third, we are preparing dissemination products, designed for specific audiences, that will address the topics more thoroughly and that will describe the benefits and limitations of potential interventions in greater detail.

Positive Reinforcement or Token Reinforcement

Synopsis

Behavioral strategies (behavior therapy, behavior modification, and contingency management) refer to interventions that use reinforcement and punishment to establish or reduce target behaviors. The ADD research literature suggests a special emphasis on a number of common behavioral interventions. The first and most important is positive reinforcement. For decreasing rates of troubling behaviors by building specific alternative desirable behaviors, positive reinforcement procedures (most often using secondary or token reinforcers) have demonstrated effectiveness under well regulated conditions. Researchers have found that relatively simple positive reinforcement programs can be effective in reducing activity level, increasing time on-task, and improving academic performance. Generalization of trained behaviors from one setting to another, however, has not been demonstrated. Additionally, some studies have indicated the superiority of continuous reinforcement over partial (intermittent) reinforcement, though other studies have found no difference. In practice, reinforcement schedules may prove most successful when they are determined on an individual student basis. Overall, behavior therapy techniques have the advantages of being cost effective, familiar to many educators, relatively easy to implement, and adaptable to multiple settings.

Suggestions for Educators

- Simple positive reinforcement of desirable behaviors should be the first intervention educators consider when developing programs for students with ADD.
- Because trained behaviors tend not to generalize, educators should train specific behaviors across appropriate settings.
- Educators should explore the effects of continuous versus partial reinforcement and individual versus group rewards, expecting to make adjustments for situational and individual child differences.

Areas for Further Study

Positive reinforcement is well established as an effective intervention with all children. Though findings from research on elementary-age students with ADD is largely consistent with research on other populations, continued investigation may help to identify or fine tune population-specific strategies. For example, researchers should compare the effects of delayed versus immediate reinforcement. To assist planners in developing effective and practical programs, researchers should also explore fidelity of implementation in school settings, especially examining whether general education teachers can use behavioral programs

effectively for students with ADD in regular classrooms. Particularly worthy of study is the area of teacher support--what in-class assistance, from human or technological resources, permits effective behavior management in the classroom with minimal disruption to teaching. Additionally, researchers should examine positive reinforcement strategies with older students with ADD.

Figure 1

Studies Using POSITIVE REINFORCEMENT or TOKEN REINFORCEMENT as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Allen, Henke, Harris, Baer, & Reynolds	1967	Laboratory preschool	1	4 4-4	Positive reinforcement	Sustained attention, social skills	Single-subject	Positive reinforcement improved sustained attention
Aylion, Layman, & Kandel	1975 *	Special education classroom	3	9 8-10	Token reinforcement, methylphenidate	Math and reading tasks, activity level, disruptive behavior	Single-subject	Methylphenidate and token reinforcement comparably effective in reducing activity levels; token reinforcement produced academic gain; methylphenidate did not
Carlson, Pelham, Milich, & Dixon	1992	Treatment facility or clinic	24	9 6-12	Token reinforcement, positive reinforcement, response-cost, school-home reinforcement, time-out, 2 dosages of methylphenidate, placebo	Math and reading tasks, time on-task, disruptive behavior, general conduct, aggression, academic and conduct self-efficacy, general self-esteem	Group	Methylphenidate or token reinforcement program, including response cost, improved classroom behavior; only methylphenidate improved academic performance; combination no better than high dose of methylphenidate alone
Christensen	1975	Treatment facility or clinic	c.16	12 9-16	Positive reinforcement, token reinforcement, methylphenidate, placebo	Math task, time on-task, activity level, general conduct	Group	Positive and token reinforcement improved time on-task, general conduct, and academic productivity
Douglas & Parry	1983 *	Laboratory	33	10 --	Positive reinforcement, schedule of reward	Reaction time	Group	Continuous and partial reward schedules improved reaction time; only continuous reward reduced response variability
Freibergs & Douglas	1969	Laboratory	65	8 6-12	Positive reinforcement, schedules of reward, ADD classification	Concept learning task	Group	Continuous reward produced the most concept problems solved; partial reward produced the fewest concept problems solved
Friedling & O'Leary	1979 *	Laboratory school classroom	8	7 6-10	Token reinforcement	Math and reading tasks, sustained attention, time on-task, teacher attention	Group	Token reinforcement produced gains in time on-task, but not in task accuracy

[1] Asterisk (*) indicates that article is annotated.
[2] Includes subjects with an attention deficit diagnosis and subjects with ADD characteristics; numbers in ( ) represent attrition.

Figure 1 (continued)

Studies Using POSITIVE REINFORCEMENT or TOKEN REINFORCEMENT as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Gittelman-Klein, Klein, Abikoff, Katz, Gloisten, & Kates	1976 *	Regular classroom	36 (2)	8 6-12	Token reinforcement at school and home, methylphenidate, combination of reinforcement ant methylphenidate, placebo	Sustained attention, activity level, general conduct, social skills	Group	Methylphenidate alone and with token reinforcement improved conduct, attention, hyperactivity, sociability, and disruptive behavior; token reinforcement with placebo did not
Horn, Chatoor, & Conners	1983 *	Treatment facility or clinic	1	9 --	Token reinforcement, self-monitoring, self-reinforcement, self-instruction/cognitive-behavioral training, dextroamphetamine, placebo	Sustained attention, time on-task, activity level, impulse control, noise	Single-subject	Dextroamphetamine and self-control training increased on-task behavior and sustained attention and decreased hyperactivity and impulsive responding; only token reinforcement improved cognitive and academic performance
O'Leary, Pelham, Rosenbaum, & Price	1976 *	Regular classroom	17	10 8-10	Positive reinforcement, school-home reinforcement	Activity level, general conduct	Group	Positive reinforcement improved hyperactivity ratings
Parry & Douglas	1983 *	Laboratory	30	9 --	Positive reinforcement, schedule of reinforcement, ADD classification	Concept identification	Group	Continual reinforcement improved concept identification
Patterson, Jones, Whittier, & Wright	1965	Treatment facility or clinic	2	10 10-10	Token reinforcement, individual and group contingencies, schedule of reinforcement	Time on-task, activity level	Single-subject	Both schedules of reward and group and individual contingencies produced increased time on-task
Pelham, Carlson, Sams, Dixon, & Hoza	In Press	Treatment facility or clinic	31	8 5-10	Token reinforcement, positive reinforcement, response-cost, school-home reinforcement, time-out, 2 dosages of methylphenidate, placebo	Math and reading task, time on-task, disruptive behavior, compliance, social skills	Group	Methylphenidate or token reinforcement program, including response cost, improved classroom behavior; only methylphenidate improved academic performance; combination slightly more effective than methylphenidate alone

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Figure 1 (continued)

Studies Using POSITIVE REINFORCEMENT or TOKEN REINFORCEMENT as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Pelham, Milich, & Walker	1986 *	Treatment facility or clinic	30	9 5-11	Positive reinforcement, token reinforcement, schedule of reinforcement, methylphenidate, placebo	Spelling task	Group	Subjects performed equally well under partial and continuous reward conditions on a nonsense spelling task; methylphenidate resulted in fewer errors on this task compared to placebo
Rosenbaum, O'Leary, & Jacob	1975 *	Regular classroom	10	10 8-12	Token reinforcement, individual and group reward	Activity level, general conduct	Group	Individual and group contingencies equally effective in reducing hyperactivity and problem behaviors; teachers preferred group contingencies
Shafio & Sulzbacher	1977	Laboratory preschool	1	4 --	Positive reinforcement, methylphenidate	Sustained attention	Single-subject	Positive reinforcement and methylphenidate improved sustained attention
Stableford, Butz, Hasazi, Leitenberg, & Peyser	1976	Regular classroom	2	9 8-11	Positive reinforcement, token reinforcement, methylphenidate, dextroamphetamine	Sustained attention, time on-task, activity level, disruptive behavior, compliance, general conduct, aggression	Single-subject	Positive and token reinforcement and stimulant medication both improved time on-task and other appropriate behaviors
Twardosz & Sajwaj	1972	Remedial preschool	1	4 --	Token reinforcement, prompting	Time on-task, activity level, social skills	Single-subject	Token reinforcement/prompting led to an increase in time on-task and other positive behaviors
Wulbert & Dries	1977	Treatment facility or clinic	1	8 --	Token reinforcement, time-out, methylphenidate, placebo	Aggression, sustained attention, activity level, sequential memory (visual and auditory)	Single-subject	Methylphenidate improved aggressive behavior, but not other problem behaviors; token reinforcement improved sequential memory and decreased ritualistic behavior

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Behavior Reduction Strategies

Synopsis

Mildly aversive procedures targeting undesirable behaviors can be effective, especially in conjunction with a reward program, in decreasing off-task behavior and, to some extent, in increasing academic productivity. Specifically, behavior therapy studies that have examined the effects of negative feedback, reprimands, or re-direction on the performance of elementary-age students with ADD have found these behavior reduction strategies to be effective. The research on reprimands (which is, essentially, research on redirection) is especially noteworthy because it demonstrates that empirical evidence can contribute to the refinement of a simple and common classroom technique. Additionally, research on response cost procedures (presented as a separate Topical Synthesis) corroborates the effectiveness of the use of behavior reduction strategies.

Suggestions for Educators

- Educators should explore the use of behavior reduction strategies, targeting undesirable behaviors, in conjunction with positive reinforcement of desired behaviors.

- Educators should use short, immediate reprimands or verbal re-direction to decrease off-task behavior, and should avoid longer reprimands.

Areas for Further Study

Given the demonstrated success of reprimands, researchers should expand this area of research to include older students with ADD and should study other forms of behavior reduction. For example, investigators should test time-out procedures with a particular focus on identifying features that will make time-out maximally effective with this population. Researchers should compare behavior reduction strategies (in combination with positive reinforcement) to determine the most efficient means of behavior change, especially in general education classrooms.

Figure 2

Studies Using BEHAVIOR REDUCTION STRATEGIES as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Abramowitz, Eckstrand, O'Leary, & Dulcan	1992 *	Treatment facility or clinic	3	10 10-11	Reprimands, timing of reprimand (immediate versus delayed), methylphenidate, placebo	Time on-task	Single-subject	Results varied among subjects though all subjects were off-task more during the delayed reprimand/placebo condition than during any other combination of immediate versus delayed reprimand and methylphenidate versus placebo treatments
Abramowitz & O'Leary	1990 *	Treatment facility or clinic	4	N/A	Timing of reprimands	Time on-task	Single-subject	Immediate reprimands reduced interactive off-task behavior better than delayed reprimands
Abramowitz, O'Leary, & Futtersak	1988 *	Treatment facility or clinic	7	N/A	Length of reprimands	Time on-task	Single-subject	Short reprimands were more effective than long reprimands in increasing time on-task
Abramowitz, O'Leary, & Rosén	1987 *	Summer school class	11	7 7-9	Positive reinforcement, reprimands, no feedback	Math task, time on-task	Group	Reprimands were most effective in promoting on-task behavior; reprimands and encouragement were inconsistently effective in increasing academic productivity
Firestone & Douglas	1975	Special testing room in school	27	9 --	Positive reinforcement, reprimands, reward and punishment combined, age, ADD classification, IQ	Reaction time and autonomic arousal	Group	All three treatment conditions improved subjects' reaction times, but reward-only increased impulsive responding
Futtersak	1988 *	Laboratory school	16	N/A	Consistently and increasingly strong reprimands	Reading task, time on-task, frequency of reprimands, subjects' attitude	Single-subject	Consistently strong reprimands produced more time on-task and better academic performance than reprimands that increased in strength

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Figure 2 (continued)

Studies Using BEHAVIOR REDUCTION STRATEGIES as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Gittelman, Abikoff, Pollack, Klein, Katz, & Mattes	1980	Regular classroom	64 (3)	8 8-12	Positive reinforcement, punishment, token reinforcement, contracting, parent training (general information and behavioral strategies), teacher training (behavior management), methylphenidate, placebo	Sustained attention, activity level, disruptive behavior, general conduct	Group	Methylphenidate with behavior therapy caused the most improvement on all dependent variables, followed by methylphenidate alone and then behavior therapy with placebo
Henry	1987	Treatment facility or clinic	6	7 4-10	Punishment, time-out, modeling, parent training (behavioral strategies), stimulant medication (specifics N/A)	Compliance, latency to compliance, and task completion	Single-subject	Stimulant medication plus parent training in behavioral strategies (including time-out) improved latency to compliance, rate of compliance, and task completion; modeling was ineffective
Hoza, Pelham, Sams, & Carlson	1992 *	Treatment facility or clinic	2	11 10-11	Positive reinforcement, time-out, response cost, school-home reinforcement, parent training (behavioral strategies), methylphenidate, placebo,	Aggression, assigned seatwork, disruptive behavior, general conduct	Single-subject	Behavior therapy (including time-out and response cost) produced improvements in disruptive behavior, task completion, and task accuracy; combinations of methylphenidate and behavior therapy varied in effectiveness
Worland	1976 *	Laboratory	16	-- 7-12	Positive reinforcement, punishment, no feedback	Time on-task, amount and accuracy of work	Group	Punishment produced increased time on-task, but decreased task-accuracy

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Response Cost

Synopsis

Response cost combines positive reinforcement and punishment through the removal of earned token reinforcers following the occurrence of undesirable target behaviors. Response cost interventions have proven to be especially effective in improving attention to task and increasing completion of academic tasks. Some studies have shown response cost to be as effective as medication or to be particularly effective in combination with medication. Additionally, commercially available electronic desk-top apparatuses for recording and deleting points make implementation of a response cost program practical in a regular classroom setting (though acceptance by target students and classmates has not been sufficiently examined).

Suggestions for Educators

- Educators should view response cost as the most effective behavioral intervention for increasing on-task behavior for students with ADD and as a potentially effective means of increasing academic productivity.
- Educators should develop response cost programs for students who do not respond sufficiently to programs consisting solely of positive reinforcement strategies.
- Educators should use response cost with confidence with elementary-age students, but should carefully monitor its use with older students.
- Educators should explore the use of commercial electronic devices for improving time on-task in general or special education classrooms.

Areas for Further Study

Researchers should test response cost programs with older subjects with ADD to determine whether the positive effects found for elementary-age students hold true for older students. To assist planners in developing effective and practical programs, researchers should also explore fidelity of response cost implementation in school settings. In addition to conventional response cost programs, investigators should explore the use of electronic apparatuses in general education classrooms to determine their practicality and their acceptance by students with ADD and their classmates.

Figure 3

Studies Using RESPONSE COST as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Cunningham & Knights	1978	Laboratory	48	10 7-12	Positive reinforcement, response cost, reinforcement schedule, age, ADD classification	Discrimination learning task	Group	Response cost produced quicker identification of the targeted stimuli than did reward, especially for younger subjects; continuous feedback more effective than partial feedback
DuPaul, Guevremont, & Barkley	1992 *	Special education classroom	2	6 6-7	Token reinforcement, response cost, (Attention Training System), combination of response cost and punishment	Reading task, time on-task, activity level, disruptive behavior	Single-subject	Response cost alone and with added punishment produced improvements in activity level, productivity, and general behavior
Gordon, Thomason, Cooper, & Ivers	1991 *	Treatment facility or clinic	6	-- 6-9	Positive reinforcement, response cost (Attention Training System)	Time on-task,	Single-subject	Positive reinforcement/response cost improved subjects' time on-task
Hall & Kataria	1992 *	Treatment facility or clinic	21	7 6-12	Positive reinforcement, response cost, self-instruction/cognitive-behavioral training, methylphenidate	Sustained attention, impulse control, treatment preference	Group	Behavioral treatment (using response-cost) and cognitive-behavioral training, both with medication, produced some improvement in sustained attention
Hoza, Pelham, Sams, & Carlson	1992 *	Treatment facility or clinic	2	11 10-11	Positive reinforcement, time-out, response cost, school-home reinforcement, parent training (behavioral strategies), methylphenidate, placebo	Assigned seatwork, disruptive behavior, general conduct, aggression	Single-subject	Behavior therapy (including response-cost) produced improvements in disruptive behavior, task completion, and task accuracy; subjects' responses to combinations of methylphenidate and behavior therapy were varied
Kendall & Braswell	1982 *	School (specifics N/A)	27	10 8-12	Positive reinforcement, response cost, self-instruction/cognitive-behavioral training	Math and reading achievement, sustained attention, time on-task, activity level, disruptive behavior, impulse control, self-esteem, social skills	Group	Behavior therapy (including response-cost) and cognitive-behavior therapy improved teacher ratings of hyperactivity
Kendall & Finch	1976	Treatment facility or clinic	1	9 --	Response cost, self-instruction/ cognitive-behavioral training	Sustained attention	Single-subject	Response cost plus self-instruction/cognitive-behavioral training increased sustained attention

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[2] Includes subjects with an attention deficit diagnosis and subjects with ADD characteristics; numbers in ( ) represent attrition.

Figure 3 (continued)

Studies Using RESPONSE COST as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Rapport, Murphy, & Bailey	1980 *	Regular classroom	1	7 --	Positive reinforcement, response cost, methylphenidate	Math task, reading task, spelling task, time on-task	Single-subject	Response cost (alone or combined with medication) effective in increasing time on-task and improving academic performance
Rapport, Murphy, & Bailey	1982 *	Regular classroom	2	-- 7-8	Positive reinforcement, response cost, methylphenidate, differing dosages of methylphenidate	Math task, reading task, time on-task	Single-subject	Both response cost and methylphenidate produced improvements in on-task behavior and academic performance; response cost had greater effect
Sullivan & O'Leary	1990 *	Summer school special education classroom	c.6	8 6-9	Positive reinforcement, response cost, reprimand	Time on-task	Single-subject	Response-cost and positive reinforcement were both effective in improving subjects' time on-task; subjects maintained behavioral gains better after the response-cost system

[1] Asterisk (*) indicates that article is annotated.
[2] Includes subjects with an attention deficit diagnosis and subjects with ADD characteristics; numbers in ( ) represent attrition.

Self-Instruction or Cognitive-Behavioral Training

Synopsis

Cognitive-behavioral therapy combines behavioral techniques with cognitive strategies designed to directly address core problems of impulse control, higher order problem solving, and self-regulation. Some evidence, though virtually none without contradiction, suggests that cognitive-behavioral therapy may produce positive changes in sustained attention, impulse control, hyperactivity, and self-concept for elementary-age children. Additionally, in preliminary investigations, correspondence training (a form of self-instruction that rewards correspondence between statements and behaviors) has demonstrated effectiveness in reducing inappropriate behaviors and may prove to offer educators a practical school-based technique. The weight of the empirical evidence, however, is against the efficacy of cognitive-behavioral therapy. As implemented and tested to date, cognitive-behavioral therapy has not consistently demonstrated positive effects on a magnitude that would recommend its widespread use, especially considering the relatively high staff investment required for implementation. Nonetheless, experienced clinicians see potential in these treatments and advocate further development and evaluation.

Suggestions for Educators

- Educators should not commit significant resources to cognitive-behavioral interventions until clinicians or researchers have refined the techniques to produce more consistent results.
- Given the intuitive appeal of these interventions and their success with other populations, educators might wish to try cognitive-behavioral therapy on a limited, exploratory basis with students with ADD.
- If educators choose to experiment with cognitive-behavioral interventions, they should focus on specific behaviors associated with school problems and should not expect generalization beyond specifically trained behaviors.
- Educators should explore the use of correspondence training, which initial investigation suggests may be an efficient and practical intervention for use in school settings.

Areas for Further Study

Because of the inconsistency of current results, researchers should examine components of cognitive-behavioral interventions to determine whether certain specific strategies are more effective than others. Similarly, researchers should focus additional attention on subject

characteristics to determine whether cognitive-behavioral interventions are more effective with a subgroup of students with ADD. Additionally, future research should study implementation of cognitive-behavioral programs in school settings, with educators as the program implementers. This research should include preschoolers and adolescents as subjects. Preliminary positive findings suggest that further study of correspondence training is especially warranted.

Figure 4

Studies Using SELF-INSTRUCTION or COGNITIVE-BEHAVIORAL TRAINING as an Intervention for Children with ADD

Authors	Year / Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Abikoff, Ganeles, Reiter, Blum, Foley, & Klein	1988	Treatment facility or clinic	34 (1)	9 7-12	Self-monitoring, self-reinforcement, self-instruction/cognitive-behavioral training, tutoring, methylphenidate, placebo	Math and reading achievement, cognitive impulsivity, general conduct, aggression, academic self-efficacy, conduct self-efficacy, general self-esteem	Group	Cognitive-behavioral training not superior to remedial tutoring or methylphenidate on self-ratings or academic, cognitive, or behavior ratings; but teachers judged cognitive-behavioral treatment as superior in producing academic gains
Abikoff & Gittelman	1985 *	Treatment facility or clinic	50 (1)	-- 6-12	Self-monitoring, self-instruction, cognitive-behavioral training, methylphenidate, dextroamphetamine, pemoline, placebo	Math, reading, and spelling tasks, sustained attention, activity level, impulse control, general conduct, cognitive abilities	Group	No differences between groups on home behavior or academic achievement; stimulant medication produced less distractibility in classroom
Abikoff & Pollack	1983 *	Special room in school	12	8 6-11	Self-monitoring, self-reinforcement, self-instruction/cognitive-behavioral training, correspondence training, methylphenidate	Math and reading achievement, academic skills tests	Group	Cognitive training improved reading achievement and academic skills tests, but not math achievement
Anderson, Clement, & Oettinger	1981	School (specifics N/A)	12	-- 6-9	Token reinforcement, self-monitoring, self-instruction/cognitive-behavioral training, methylphenidate, placebo	Sustained attention	Group	Methylphenidate produced greater gains than self-instruction training in sustained attention
Barkley, Copeland, & Sivage	1980	Treatment facility or clinic	6	-- 7-10	Self-monitoring, self-instruction/cognitive-behavioral training	Time on-task, compliance, general conduct	Single-subject	Self-monitoring and reward improved general conduct and time on task during individual work periods, but not during group instruction; intervention did not affect activity level and no generalization to school occurred
Bloomquist, August, & Ostrander	1991 *	Regular classroom	52 (16)	N/A	School-home reinforcement, self-instruction/cognitive-behavioral training, parent training (information, behavioral, and cognitive-behavioral strategies), and teacher training (behavior management and problem solving)	Sustained attention, time on-task, activity level, impulse control, general conduct, aggression, general self-esteem, social status	Group	Multisituational cognitive-behavioral therapy effective in reducing subjects' off-task/disruptive behavior

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Figure 4 (continued)

Studies using SELF-INSTRUCTION or COGNITIVE-BEHAVIORAL TRAINING as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Borden, Brown, Wynne, & Schlesser	1987 *	Treatment facility or clinic	29	9 6-12	Self-instruction/cognitive-behavioral training, cognitive developmental level	Math, reading, and spelling achievement, sustained attention, time on-task, cognitive impulsivity, general conduct	Group	No significant differences between developmental levels on any measure except cognitive impulsivity; the Piagetian non-conservers improved on this measure after cognitive training
Bornstein & Quevillon	1976	Headstart facility	3	4 4-4	Self-reinforcement, self-instruction/cognitive-behavioral training	Time on-task	Single-subject	Cognitive training/self-instruction produced large gains in on-task behavior
Brown	1980	Treatment facility or clinic	118 (2)	11 8-13	Self-instruction/cognitive-behavioral training, methylphenidate, dextroamphetamine, modeling, age	Copying task, matching task	Group	Stimulant medication combined with either modeling or self-instruction improved copying and coding performance
Brown, Borden, Wynne, Schleser, & Clingerman	1986 *	Laboratory	40 (7)	9 5-13	Self-instruction/cognitive-behavioral training, methylphenidate, placebo	Math and reading achievement, listening task, sustained attention, activity level, impulse control, general conduct, social skills	Group	No treatment proved superior to any other on academic or behavioral measures
Brown, Wynne, Borden, Clingerman, Geniesse, & Spunt	1986 *	Laboratory	40 (5)	9 5-13	Self-instruction/cognitive-behavioral training, methylphenidate, combination of methylphenidate and self-instruction/cognitive-behavioral training	Sustained attention, activity level, disruptive behavior, impulse control, social skills	Group	No treatment superior to any other on academic or behavioral measures
Brown, Wynne, & Medenis	1985 *	Laboratory	40	11 6-11	Self-instruction/cognitive-behavioral training, methylphenidate, combination of methylphenidate and self-instruction/cognitive-behavioral training	Math and reading achievement, sustained attention, impulse control	Group	Cognitive-behavioral therapy (with and without methylphenidate) resulted in decreased impulsivity; cognitive behavioral therapy alone slightly improved attention; methylphenidate (with and without cognitive-behavioral therapy) produced improvements in sustained attention and behavior

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Figure 4 (continued)

Studies using SELF-INSTRUCTION or COGNITIVE-BEHAVIORAL TRAINING as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Bugental, Collins, Collins, & Chaney	1978	Regular classroom	20	11 7-12	Positive reinforcement, self-instruction/cognitive-behavioral training, methylphenidate	Impulse control, academic self-efficacy, activity level	Group	Cognitive-behavioral training produced greater long-term academic self-efficacy than did positive reinforcement; positive reinforcement produced lower activity levels
Bugental, Whalen, & Henker	1977	Regular classroom, special education classroom	36	11 7-12	Positive reinforcement, self-instruction/cognitive-behavioral training, methylphenidate, attribution of causality	Impulse control, academic self-efficacy, activity level	Group	Cognitive-behavioral training decreased impulsivity for subjects who had high academic self-efficacy or were not medicated; positive reinforcement caused some decrease in impulsivity for subjects who had low self-efficacy or were medicated
Cameron & Robinson	1980	Special education classroom	3	8 7-8	Self-instruction/cognitive-behavioral training	Math task, reading task, time on-task	Single-subject	Cognitive-behavioral training improved time on-task and math and reading performance
Chase & Clement	1985 •	Laboratory school	6	10 9-12	Positive reinforcement, token reinforcement, self-reinforcement, methylphenidate, placebo	Reading task	Single-subject	Self-reinforcement plus methylphenidate improved academic performance more than either treatment alone
Cohen, Sullivan, Minde, Novak, & Helwig	1981 •	Laboratory	24 (3)	5 --	Self-instruction/cognitive-behavioral training, parent training (informational), teacher training (cognitive behavior modification), methylphenidate	Sustained attention, activity level, impulse control, conduct self-efficacy, general self-esteem, social skills	Group	No differences between treatment groups on cognitive and behavioral measures
Douglas, Parry, Marton, & Garson	1976 •	Treatment facility or clinic	29	8 6-10	Self-reinforcement, self-instruction/ cognitive-behavioral training, parent training (informational and behavioral strategies), teacher training (child self-management)	Math achievement, word recall, reading task, perceptual motor skills, sustained attention, activity level, disruptive behavior, impulse control, aggression	Group	Self-instruction training combined with parent and teacher training improved scores on tests of impulsivity, aggression, coping strategies, and listening comprehension; but teacher ratings did not show treatment effect
Eastman & Rasbury	1981	Resource classroom	11	N/A	Self-instruction/cognitive-behavioral training	Reading task, time on-task, self-verbalizations	Group	Self-instruction techniques produced improved task accuracy on easy math problems

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Figure 4 (continued)

Studies using SELF-INSTRUCTION or COGNITIVE-BEHAVIORAL TRAINING as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Friedling & O'Leary	1979 •	Laboratory school	8	7 6-10	Self-instruction/cognitive-behavioral training, positive reinforcement	Math task, reading task, time on-task, teacher attention	Group	Self-instruction training improved math accuracy; token reinforcement added to the training program increased time on-task
Guevremont, Tisheiman, & Hull	1985 •	Treatment facility or clinic	2	9 9-10	Self-instruction/cognitive-behavioral training, concrete versus conceptual training, parent training (as adjunct therapists)	Math and reading achievement, daily worksheets, disruptive behavior, impulse control, general conduct	Single-subject	Self-instruction therapy produced improvements in productivity, self-control, activity levels, and school grades
Hall & Kataria	1992 •	Treatment facility or clinic	21	7 6-12	Positive reinforcement, response cost, self-instruction/cognitive-behavioral training, methylphenidate	Sustained attention, impulse control, treatment preference	Group	Cognitive-behavioral training combined with medication improved impulsive responses; behavioral treatment and cognitive-behavioral training, both with medication, produced some improvement in sustained attention; parents preferred cognitive-behavioral therapy alone or with medication
Hinshaw, Henker, & Whalen	1984 a •	Treatment facility or clinic	24 (2)	8-13 --	Positive reinforcement, self-instruction/cognitive-behavioral training (self-evaluation), methylphenidate, placebo,	Compliance, aggression, social skills	Group	Reinforced self-evaluation more effective than simple reinforcement, and methylphenidate more effective than placebo in improving social behavior; reinforced self-evaluation equally effective combined with methylphenidate or placebo
Hinshaw, Henker, & Whalen	1984 b •	Treatment facility or clinic	24 (1)	8-13 --	Self-instruction/cognitive-behavioral training, methylphenidate, placebo	Activity level, impulse control, aggression, reaction intensity	Group	Cognitive-behavioral training resulted in significantly more self-control and coping strategies than control training; no significant medication effect except in reaction intensity
Hinshaw & Melnick	1992 •	Laboratory	2	9 9-10	Stimulus control, self-monitoring, self-instruction/cognitive-behavioral training	N/A	Case study	Cognitive-behavioral training in control produced gains in subjects' self-control; methylphenidate caused subjects to better tolerate provoking situations

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Figure 4 (continued)

Studies using SELF-INSTRUCTION or COGNITIVE-BEHAVIORAL TRAINING as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Horn, Ialongo, Greenberg, Packard, & Smith-Winberry	1990 *	Treatment facility or clinic	42	9 7-11	School-home reinforcement, self-instruction/cognitive-behavioral training, relaxation training, parent training (behavioral strategies), ADD classification	Math and reading achievement, activity level, disruptive behavior, impulse control, general conduct, aggression, general self-esteem	Group	None of the treatments, or combinations of treatments proved more effective than the others, though parents reported that the multimodal treatment produced improvements in some behaviors
Horn, Ialongo, Popovich, & Peradotto	1987 *	Treatment facility or clinic	24 (5)	10 8-12	Self-instruction/cognitive-behavioral training, parent training (behavioral strategies)	Math and reading achievement, cognitive ability, sustained attention, time on-task, activity level, disruptive behavior, impulse control, general conduct, aggression, conduct self-efficacy, general self-esteem, parent attitudes	Group	Cognitive-behavioral self-control therapy, behavioral parent training, and a combination of treatments all produced behavioral improvements in the home
Kendall & Braswell	1982 *	School (specifics N/A)	c.27	10 8-12	Positive reinforcement, response cost, self-instruction/cognitive-behavioral training	Math and reading achievement, sustained attention, time on-task, activity level, disruptive behavior, impulse control, general self-esteem, social skills	Group	Cognitive-behavioral therapy and behavior therapy both produced improved teacher ratings of hyperactivity
Kendall & Finch	1976	Treatment facility or clinic	1	9 --	Response cost, self-instruction/cognitive-behavioral training,	Sustained attention	Single-subject	Response cost plus self-instruction training increased sustained attention
Kendall & Finch	1979	Treatment facility or clinic	18	11 --	Self-instruction/cognitive-behavioral training, impulsive versus reflective cognitive style	Time on-task, verbalizations	Group	Cognitive-behavioral training increased on-task verbalizations at posttest, but increases were not maintained at follow-up
Kendall & Zupan	1981	Therapy room in school	c.15	9 8-11	Self-reinforcement, self-instruction/cognitive-behavioral training, nonspecific group treatment	Psychoeducational tests, sustained attention, activity level, impulse control, cognitive/performance tests	Group	Individual and cognitive-behavioral training significantly improved self-control; all treatments (including control) improved hyperactivity
Moore & Cole	1978 *	Treatment facility or clinic	14	9 8-12	Self-reinforcement, self-instruction/cognitive-behavioral training	Matching/embedded figures task, general conduct	Group	Cognitive-behavior/self-instruction therapy improved cognitive impulsivity and scanning ability, and produced higher scores on several WISC-R subtests

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Figure 4 (continued)

Studies using SELF-INSTRUCTION or COGNITIVE-BEHAVIORAL TRAINING as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Palkes, Stewart, & Kahana	1968	Laboratory	20	9 8-11	Self-instruction/cognitive-behavioral training	Impulse control	Group	Self-directed verbal command training significantly improved performance on a maze test by reducing errors and impulsive responding
Paniagua	1992 *	Treatment facility or clinic	5	8 6-10	Positive reinforcement, self-instruction/cognitive-behavioral training, correspondence training	Sustained attention, activity level, disruptive behavior, impulse control, general conduct, aggression	Single-subject	All three variants of correspondence training reduced inappropriate behaviors
Paniagua & Black	1990 *	Treatment facility or clinic	8	8 6-10	Positive reinforcement, correspondence training	Math and reading tasks, time on-task, activity level, disruptive behavior, aggression, destructiveness	Single-subject	Correspondence training decreased inattention, overactivity, and conduct disorders
Paniagua, Morrision, & Black	1990 *	Treatment facility or clinic	1	7 --	Correspondence training	Sustained attention, activity level, general conduct, aggression, noise	Single-subject	Correspondence training markedly decreased inattention, overactivity, and noise
Paniagua, Pumeriega, Black	1988 *	Treatment facility or clinic	3	7 6-9	Positive reinforcement, correspondence training	Sustained attention, time on-task, activity level, disruptive behavior, corresponding reports	Single-subject	Correspondence training decreased activity level, inattention, and off-task behavior and increased correspondence between verbal and nonverbal behavior
Pelham, Schnedler, Bologna, & Contreras	1980 *	Regular classroom	9 (1)	8 6-10	Positive reinforcement, punishment, school-home reinforcement, self-instruction/cognitive-behavioral training, parent training (behavioral strategies), teacher training (behavior management), methylphenidate, placebo	Time on-task, disruptive behavior, aggression, parent-child interactions	Single-subject	Cognitive-behavioral therapy did not produce significant gains in any area; behavioral intervention combined with methylphenidate produced the most improvements in on-task behavior
Rosén, O'Leary, & Conway	1985 *	Laboratory school	1	9 --	Attribution training, positive reinforcement, combined school-home reinforcement, methylphenidate fading	Assigned seatwork, sustained attention, time on-task, disruptive behavior, compliance, aggression, academic self-efficacy, conduct self-efficacy	Case study	Attribution training ameliorated beliefs that medication controlled behavior; withdrawal of medication without attribution training or placebo caused a deterioration in behavior and performance; withdrawal of medication and placebo with training caused no marked deterioration in behavior or performance

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Figure 4 (continued)

Studies using SELF-INSTRUCTION or COGNITIVE-BEHAVIORAL TRAINING as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Satterfield, Satterfield, & Scheli	1987 *	Treatment facility or clinic	186 (55)	-- 6-12	Various behavioral approaches, self-instruction/cognitive-behavioral training, parent training (informational and behavioral strategies), individualized multimodal therapy psychotherapy, methylphenidate	Felonies/institutionalizations	Group	Subjects receiving multimodality treatment (including cognitive-behavioral therapy) far less likely to be felony offenders or to be institutionalized than subjects treated only with methylphenidate
Varni & Henker	1979 *	Treatment facility or clinic, regular classroom	3	9 8-10	Self-monitoring, self-reinforcement, self-instruction/cognitive-behavioral training	Math task, reading task, time on-task, activity level	Single-subject	Self-instruction training and self-monitoring ineffective, but the addition of self-reinforcement resulted in increased academic performance and decreased hyperactivity
Weithorn & Kagen	1979	Laboratory	c.47	6 5-7	Self-instruction/cognitive-behavioral training, achievement level, ADD classification	Perceptual matching task	Group	Self-instruction training resulted in significantly fewer errors on multiple-choice test of perceptual matching

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Parent or Family Training

Synopsis

The ADD literature contains many examples of moderately successful training programs with parents and families of elementary-age children, usually designed to extend or enhance clinical treatment. For most of the studies, the training curriculum consists of behavioral strategies applicable to home problems or designed to support school- or clinic-based interventions. Such training has demonstrated some effectiveness in reducing activity level, conflict, and anger intensity, and in increasing on-task behavior and compliance. A number of studies also reported reduced parent stress or improvements in parents' perceptions of the quality of parent-child interactions following parent training. Behavioral parent training is a standard component of multi-modal interventions, which have demonstrated some success across a variety of outcomes. Importantly, clinic-based mental health professionals typically have provided the parent training, and school personnel have served as trainers in none of the studies.

Suggestions for Educators

- As an adjunct to other interventions for students with ADD, educators should consider providing parent training programs in collaboration with experienced clinicians.
- Parent training should include information about ADD, but the primary emphasis should be on behaviorally oriented management strategies.
- To ensure that parent training has an impact on school behavior, school-based training should focus on the implementation of strategies that foster home-school collaboration, such as home contingencies for school performance and techniques to encourage homework completion.

Areas for Further Study

Researchers should continue to evaluate parent training as a component of multi-modal interventions, examining especially the long-term efficacy of these interventions and the effectiveness of these interventions with parents of adolescents. Educators will be particularly interested in the development and evaluation of school-based parent training programs, particularly those conducted by school personnel. Investigators should compare effects, especially on school performance, of school-based versus clinic-based parent training programs. Researchers should also focus on refining strategies for facilitating generalization of training effects from the home to the classroom, including refining techniques for effective use of home contingencies to support the improvement of school behaviors. Further study is

also warranted on the relative merits of training conducted by parent trainers with cultural roots in the target communities.

Figure 5

Studies Using PARENT or FAMILY TRAINING as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Barkley, Ouevremont, Anastopoulos, & Fletcher	1992 •	Treatment facility or clinic	64 (3)	-- 12-17	Parent training (behavioral strategies, structural family therapy), problem-solving and communication training, school adjustment, age	Activity level, general conduct, aggression, social skills, parent-child interaction, marital satisfaction	Group	All three treatment groups self-reported improvements in parent-child interactions and school adjustment; clinical measures showed slight improvements and no differences between groups
Bloomquist, August, & Ostrander	1991 •	Regular classroom	52 (16)	N/A	School-home reinforcement, self-instruction, parent training (informational, behavioral and cognitive-behavioral strategies), teacher training (behavior management and problem solving)	Sustained attention, time on-task, activity level, impulse control, general conduct, aggression, general self-esteem, social status	Group	Multicomponent treatment resulted in reduction in off-task/disruptive behavior; no other results significant; at 6-week follow-up, there were no differences between groups
Douglas, Parry, Marton, & Garson	1976 •	Treatment facility or clinic	29	8 6-10	Self-reinforcement, self-instruction, parent training (informational and behavioral strategies), teacher training (child self-management instruction)	Math achievement, word recall, reading task, perceptual-motor task, sustained attention, activity level, disruptive behavior, impulse control, aggression	Group	Cognitive therapy treatment, supported by parent training, resulted in improvements in cognitive performance but not in global teacher behavior ratings
Dubey & Kaufman	1978 •	Treatment facility or clinic, home	26 (1)	9 6-10	Parent training (informational and behavioral strategies)	Activity level, general conduct, parenting skills, parent-child interactions	Group	Parent training in behavioral strategies resulted in reductions in hyperactivity and behavior problems
Dubey, O'Leary, & Kaufman	1983 •	Laboratory, treatment facility or clinic	44 (12)	8 8-9	Parent training (behavioral strategies and parenting effectiveness)	Activity level, disruptive behavior, parenting skills, parent-child interactions	Group	Parent training in behavioral strategies superior to training in communication, though both reduced hyperactivity, problem severity, and problem occurrence
Erhardt & Baker	1990 •	N/A	2	5 5-5	Parent training (behavioral strategies)	Sustained attention, activity level, disruptive behavior, compliance, general conduct, aggression, social skills, parenting skills, parent-child interactions	Case study	Parent training resulted in increases in quality of parent-child interactions and modest gains in child compliance

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Figure 5 (continued)

Studies using PARENT or FAMILY TRAINING as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Firestone, Crowe, Goodman, & McGrath	1986 *	Treatment facility or clinic	73 (42)	-- 5-9	Parent training (informational and behavioral strategies), methylphenidate, placebo	Reading achievement, time on-task, impulse control, compliance, reaction time	Group	Methylphenidate, with or without parent training, improved attention and behavior (but not academic performance) significantly more than did parent training alone
Firestone, Kelly, Goodman, & Davey	1981 *	Treatment facility or clinic	79 (36)	7 --	Parent training (behavioral strategies), methylphenidate, placebo	Math and reading achievement, activity level, impulse control, emotional adjustment	Group	Methylphenidate superior to parent training in producing academic, behavioral, and emotional gains
Gittelman, Abikoff, Pollack, Klein, Katz, & Mattes	1980	Regular classroom	64 (3)	8 8-12	Positive reinforcement, punishment, token reinforcement, contracting, parent training (informational and behavioral strategies), teacher training (behavior management), methylphenidate, placebo	Sustained attention, activity level, disruptive behavior, general conduct	Group	Behavior therapy (including parent training) plus methylphenidate caused superior improvement on all dependent variables, followed by methylphenidate alone and last by behavior therapy with placebo
Guevremeont, Tishelman, & Hull	1985 *	Treatment facility or clinic	2	9 9-10	Self-instruction/cognitive behavioral training, concrete versus conceptual training, parent training (adjunct therapists)	Math and reading achievement, daily worksheets, disruptive behavior, impulse control, general conduct	Single-subject	Self-instruction training, supported by parent training, improved classroom work completion, self-control, and activity
Horn, Ialongo, Greenberg, Packard, & Smith-Winberry	1990 *	Treatment facility or clinic, school (specifics N/A), home	42 (8)	9 7-11	School-home reinforcement, self-instruction/cognitive-behavioral training, relaxation training, parent training (behavioral strategies), ADD classification	Math and reading achievement, activity level, disruptive behavior, impulse control, general conduct, aggression, general self-esteem	Group	Combined self-control instruction and parent training in behavioral strategies not superior to either treatment alone; no treatment produced gains in academic achievement or cognitive style
Horn, Ialongo, Popovich, & Peradotto	1987 *	Treatment facility or clinic	24 (5)	9 7-11	Self-instruction/cognitive-behavioral training, parent training (behavioral strategies)	Math and reading achievement, cognitive ability, sustained attention, time on-task, activity level, disruptive behavior, impulse control, general conduct, aggression, conduct self-efficacy, general self-esteem, parent attitudes	Group	Combined cognitive-behavioral therapy and parent training in behavioral strategies not superior to either treatment alone; all treatments produced behavioral improvements in the home

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Figure 5 (continued)

Studies using PARENT or FAMILY TRAINING as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Hoza, Pelham, Sams, & Carlson	1992 *	Treatment facility or clinic	2	11 10-11	Positive reinforcement, punishment, response cost, school-home reinforcement, parent training (behavioral strategies), methylphenidate, placebo	Assigned seatwork, disruptive behavior, general conduct, aggression	Single-subject	Different "doses" of behavior therapy (including school-home reinforcement) combined with methylphenidate improved disruptive behavior, academic work completion, and accuracy
O'Leary & Pelham	1978	Laboratory, regular classroom, home	10 (3)	8 8-10	Individualized behavioral strategies, self-monitoring, parent training (behavioral strategies), teacher training (behavior management), methylphenidate, pemoline, dextroamphetamine, withdrawal of medication	Sustained attention, time on-task, activity level, disruptive behavior, general conduct, aggression, social skills	Group	Behavioral treatment alone (including parent training) and methylphenidate alone improved attentional skills and social behaviors, with individual children showing varied degrees of improvement
Pelham	1977	Regular classroom	1	9 --	Home-school behavioral intervention, parent training (behavioral strategies), teacher training (behavior management), withdrawal of methylphenidate	Activity level, general conduct	Case study	Behavioral intervention (including parent training) was as effective as methylphenidate in improving behavior and activity level
Pelham, Schnedler, Bender, Nilsson, Miller, Budrow, Ronsei, Paluchowski, & Marks	1988	Regular classroom and Saturday sessions	32 (2)	7 5-10	Positive reinforcement, token reinforcement, combined school-home reinforcement, social skills training, parent training (behavioral strategies), teacher training (behavior management), methylphenidate	Achievement test, disruptive behavior, impulsivity, compliance, general conduct, aggression	Group	Behavior therapy, implemented through parent and teacher training produced gains on all measures; social skills training and no treatment did not; methylphenidate plus behavior therapy produced better teacher ratings than placebo plus behavior therapy
Pelham, Schnedler, Bologna, & Contreras	1980 *	Regular classroom	9 (1)	8 6-11	Positive reinforcement, punishment, school-home reinforcement, self-instruction/cognitive-behavioral training, parent training (behavioral strategies), teacher training (behavior management), methylphenidate, withdrawal of methylphenidate	Time on-task, disruptive behavior, aggression, parent-child interactions	Single-subject	Behavioral parent and teacher training improved on-task behavior and parent-child interaction; methylphenidate enhanced treatment effects

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Figure 5 (continued)

Studies using PARENT or FAMILY TRAINING as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Pisterman, Firestone, McGrath, Goodman, Webster, Mallory, & Goffin	1992(a) *	Treatment facility or clinic	91	4 3-6	Parent training (behavioral strategies)	Parents' sense of parenting competence	Group	Parent training in behavioral strategies resulted in less parenting stress and increased sense of competence post-treatment and at follow-up
Pisterman, Firestone, McGrath, Goodman, Webster, Mallory, & Goffin	1992(b)	Treatment facility or clinic	45	4 3-6	Parent training (informational and behavioral strategies)	Sustained attention, compliance, parenting skills, parent-child interactions	Group	Group parent training improved child compliance, parenting skills, and parents' style of interaction. Child attention did not improve.
Pisterman, McGrath, Firestone, Goodman, Webster, & Mallory	1989 *	Treatment facility or clinic	50 (4)	4 3-6	Parent training (informational and behavioral strategies)	Compliance, parenting skills, parent-child interactions	Group	Parent training in behavioral strategies produced improvements in child compliance, parental style of interaction, management skills, and parent-child interactions
Pollard, Ward, & Barkley	1983 *	Treatment facility or clinic	3	-- 6-7	Parent training (behavioral strategies), methylphenidate	Activity level, disruptive behavior, compliance, general conduct, parenting skills, parent-child interactions	Single-subject	Parent training in behavioral strategies combined with methylphenidate improved child behavior at home, though the combination was only marginally superior to either treatment alone
Satterfield, Satterfield, & Schell	1987 *	Treatment facility or clinic	186 (55)	-- 6-12	Various behavioral approaches, self-instruction/cognitive-behavioral training, parent training (informational, behavioral strategies, and individual multimodal psychotherapy), methylphenidate, length of treatment	Felonies, institutionalizations	Group	Multimodal treatment (that included parent training) lasting more than 2 years was superior to drug therapy in long-term outcomes of felony arrests and institutionalizations

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Figure 5 (continued)

Studies using PARENT or FAMILY TRAINING as an Intervention for Children with ADD

Authors	Year Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Schaefer, Palkes, & Stewart	1974	N/A	9	N/A	Parent training (behavioral strategies)	Compliance, parenting skills, parent-child interactions	Case study	According to parent reports, parent training improved parenting skills, parent attitudes, family interactions, and children's problem behaviors
Strayhorn & Weidman	1989 *	Treatment facility or clinic	42	3 2-5	Parent training (behavioral strategies) and extensive versus minimal treatment	Sustained attention, activity level, disruptive behavior, aggression, parent-child interactions	Group	Parent-child interaction training resulted in improvements in parenting behaviors and child behaviors; results did not generalize to the classroom
Strayhorn & Weidman	1991 *	Treatment facility or clinic	42	5 --	Parent training (informational, behavioral strategies, and interaction skills), age, gender	Reading achievement, activity level, general conduct, aggression, parenting skills, parent-child interactions, cognitive ability, depression	Group	At one-year follow-up, parent-child interaction training resulted in improvements in teacher ratings of experimental subjects compared to control subjects
Thurston	1979 *	Treatment facility or clinic	18	-- 6-9	Parent training (behavioral strategies), methylphenidate	activity level, impulse control	Group	Parent training in behavioral strategies reduced activity levels significantly more than no treatment and produced overall behavior improvements superior to drug therapy

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Task or Environmental Stimulation

Synopsis

In contrast to prior environmental stimulation research, which was based on the theory that students with attention deficits need minimal stimulation, most of the recent research on task stimulation is based on optimal stimulation theory and has looked at ways to increase rather than decrease stimulation. The increased stimulation is not general, however, but is focused on salient features of materials and instruction. Using simulated instructional activities or materials, investigators have varied features, such as color, rate of presentation, and response activity, and have demonstrated improvement in performance and behavior of students with ADD. This exploration of the application of optimal stimulation theory offers promise for finding an academic treatment, based on optimally stimulating instruction and materials, that may be unique to students with ADD. Though the research in this area is encouraging, the findings must be viewed with caution because few of the studies we reviewed were conducted in classrooms, the outcome measures employed are of limited educational relevance, and, therefore, the conclusions drawn are inferential.

Suggestions for Educators

- In planning instruction, educators should explore the effects of varying rates of presentation and varying levels of detail on the comprehension of students with ADD.
- Educators should explore ways for students to actively respond during academic tasks or should consider providing alternative motor activities.
- In developing instructional materials for students with ADD, particularly with rote learning tasks, educators should explore the effectiveness of adding color to salient features and increasing novelty, especially toward the end of tasks.

Areas for Further Study

Researchers should follow the promising results from the exploration of optimal stimulation theory by developing and testing instructional materials that provide varying levels and types of stimulation. Similar research on instructional techniques is also appropriate. This research on materials and instruction should focus on improving academic achievement as well as task performance and behaviors. Researchers should also investigate ways that existing materials can be modified to make them more useful to students with ADD. Additionally, researchers should study the role that computers and other technologies can play in the education of these students.

Figure 6

Studies Using TASK or ENVIRONMENTAL STIMULATION as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Ceci & Tishman	1984	Laboratory	30	8 8-8	Task stimulation (interval/rate and novelty), ADD classification	Shape recognition test	Group	Slow presentation rates facilitated recognition of target pictures; fast rates hindered recognition; familiar shapes were more easily recognized than nonfamiliar shapes
Chee, Logan, Schachar, Lindsay, & Wachsmuth	1989	Treatment facility or clinic, secluded room in school	41	8 6-12	Task stimulation (interval/rate), ADD classification	Sustained attention, reaction time/accuracy	Group	Both fast and slow stimulus presentation rates resulted in poorer performance on a letter recognition task; with display time held constant, only slow stimulus presentation rates resulted in poor performance
Conte, Kinsbourne, Swanson, Zirk, & Samuels	1986 *	Laboratory	16	11 8-12	Task stimulation (interval/rate), list length), ADD classification	Paired associate learning	Group	Subjects benefitted from slow-rate items in mixed-rate paired associate lists; with fixed-rate lists, the slow rate interfered with learning
Flynn & Rapoport	1976 *	Regular classroom	30	9 7-12	Formality of classroom, methylphenidate, imipramine	Math and reading achievement, activity level, disruptive behavior, impulsivity, aggression	Group	Open and traditional classrooms showed no significantly different effects on behavioral or academic improvement
Radosh & Gittelman	1981	Treatment facility or clinic	20	9 7-10	Task stimulation (high, low, and no-appeal distraction), ADD classification	Math task	Group	High appeal distractors increased arithmetic errors more than did low-appeal and no-appeal distractors
Scott	1970	Treatment facility or clinic	4	-- 7-11	Music, isolation booths	Math task	Case study	Music, isolation booths, and both combined caused an increase in the number of math problems completed correctly

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Figure 6 (continued)

Studies Using TASK or ENVIRONMENTAL STIMULATION as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied *	Outcome Measures	Study Design	Relevant Findings
Shroyer & Zentall	1986 *	Laboratory	12	8 6-9	Task stimulation (interval/rate and novelty), ADD classification	Listening comprehension task, time on-task, activity level	Group	Stories presented slightly faster than the normal rate of speech had the most beneficial effects on activity level and performance
Somervill, Warnberg, & Bost	1973	Empty classroom	24	7 6-7	Reduced stimulation, normal stimulation, increased stimulation, token reinforcement, diagnosis, race	Perceptual motor tasks, design tasks, picture completion, coloring task	Group	No significant differences between treatment groups on any dependent variable
Steinkamp	1980	Laboratory	13	8 --	Adult presence, distraction levels, diagnosis	Math task, time on-task	Group	Adult presence caused slightly improved time on-task; distraction-free room did not cause improvement on any variable
Worland, North-Jones, & Stern	1973 *	Laboratory	24	-- 7-12	Distraction levels, reward, diagnosis	Coding, activity level, tone discrimination	Group	Distraction impeded performance on the coding and tone discrimination tasks
Zentall	1980	Regular classroom	31	7 4-10	Environmental stimulation (adult presence and formality of classroom), task stimulation (motor responses and novelty), ADD classification	Time on-task, activity level, disruptive behavior, noise/vocalizations	Group	Low task stimulation resulted in more noise, disruptive behavior, and off-task behavior; increased self-stimulation occurred in high task stimulation conditions; type of off-task behavior varied with amount of classroom structure
Zentall	1985 *	Laboratory	35	9 5-13	Task stimulation (color), age, gender, ADD classification	Activity level, task accuracy/speed	Group	Color added to tasks improved task performance initially, but improvement diminished with time and with narrow-focus tasks; activity level increased in latter sessions, especially when noncolor tasks were last
Zentall	1986 *	Experimental room in school	66	9 5-13	Task stimulation (color and early vs. late timing), task order, gender, ADD classification	Task accuracy on vigilance and concept tasks, activity level	Group	Delayed high-stimulation reduced activity levels on a conceptual task; early stimulation reduced activity levels on a vigilance task

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Figure 6 (continued)

Studies Using TASK or ENVIRONMENTAL STIMULATION as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Zentall	1989 •	Laboratory	20	N/A	Task stimulation (color), ADD classification	Spelling recognition task, activity level, verbalizations	Group	Black letters followed by colored letters produced the best accuracy on spelling recognition tasks
Zentall & Dwyer	1989 •	Laboratory	12	8 --	Task stimulation (color)	Matching task, activity level	Group	The colored version, compared to the black and white version, of the MFFT caused a reduction in activity and impulsivity
Zentall, Falkenberg, & Smith	1985 •	Laboratory	16	-- 14-18	Task stimulation (color), ADD classification	Repetitive copying task, activity level	Group	Color added to the task improved copying performance
Zentall & Gohs	1984 •	Laboratory	13	6 3-7	Task stimulation (global vs. detailed)	Listening tasks, requests for information	Group	Detailed information (presented initially) resulted in longer task completion time and more requests for cues
Zentall, Gohs, & Culatta	1983 •	Laboratory	13	-- 4-7	Task stimulation (various), ADD classification	Activity level, language production	Group	Transitions between tasks and tasks requiring delayed responding caused high rates of verbal and nonverbal activity
Zentall & Kruczek	1988	Isolated room in school	17	11 8-12	Task stimulation (color)	Copying task, time on-task, activity level	Group	Color added to relevant detail improved task performance more than did color assigned to randomly selected letters; sustained attention declined in later tasks and sessions
Zentall & Leib	1985 •	School library	15	11 8-12	Task stimulation (structure), ADD classification	Design replication task, activity level	Group	High structured art project produced lower activity levels than low structured art project
Zentall & Meyer	1987 •	Empty classroom or school office	22	10 6-12	Task stimulation (motor responses), difficulty order, task order, ADD classification	Reading task, time on-task, activity level, talk/noise	Group	Active-responding produced improved performance in sustained auditory attention and word recognition

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Figure 6 (continued)

Studies Using TASK or ENVIRONMENTAL STIMULATION as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Zentall & Shaw	1980 *	Laboratory	24	8 7-9	Noise level, ADD classification	Reading and math tasks, activity level	Group	High noise levels caused hyperactive subjects to perform poorly on math and letter identification tasks; high noise also increased activity levels
Zentall & Zentall	1976	Experimental room in school	16	-- 7-11	Various visual, auditory, and lighting stimuli	Sequential letter circling task, activity level	Group	High stimulus environment caused a decrease in activity levels
Zentall, Zentall, & Barack	1978	Experimental room in school	25	8 5-10	Task stimulation (color), ADD classification	Visual-motor task	Group	Use of color versus noncolor task materials did not significantly affect error rate or completion time

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Biofeedback

Synopsis

Research activity in the use of relaxation techniques and biofeedback with children with ADD has waned in recent years, though some preliminary results indicated that these procedures had broad positive effects. Most results, however, were based on extended treatments in clinical or laboratory settings, sometimes combining academic tutoring with biofeedback treatment. For practical reasons, relaxation treatments have greater potential than brain wave or muscle tension biofeedback for application in schools, but these treatments have not been adequately tested in school settings. Overall, compared with biofeedback techniques, other treatments may be far more effective, efficient, and appropriate for educators.

Suggestions for Educators

- Educators should be skeptical about the generalization to school settings of treatment effects established in clinics.
- Muscle tension feedback is more practical than brain wave feedback for treatment in a school setting and may be worth exploring on an experimental basis in well controlled studies. Relaxation therapy is still more practical as a school-based intervention; educators might explore these techniques, also on an experimental basis.
- Based on research to date, educators should not invest significant resources in biofeedback, because these resources could better be used for treatments with greater evidence of effectiveness.

Areas for Further Study

To ensure relevance to educators, investigators should conduct any future research on biofeedback using subjects who represent a cross-section of the school population with ADD. Ideally, researchers should focus on procedures that can be implemented in school settings by school personnel, within the time and budget constraints schools face. Considering these conditions, relaxation therapy and muscle tension feedback have sufficient potential to warrant further investigation.

Figure 7

Studies Using BIOFEEDBACK as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Braud	1978 *	Laboratory	15	-- 6-15	ADD classification, autonomic responses and EMG (muscle tension) biofeedback, methylphenidate, muscle relaxation (with audiotape)	Cognitive abilities, sustained attention, on-task behavior, activity level, disruptive behavior, impulse control, compliance, general conduct, aggression, autonomic and muscle relaxation	Group	EMG biofeedback and muscle relaxation training both reduced muscle tension and disruptive behaviors
Braud, Lupin, & Braud	1975 *	Laboratory	1	6 --	EMG (muscle tension) biofeedback	Activity level, impulse control, general conduct, self-esteem, muscle tension	Case study	EMG biofeedback reduced muscle tension and activity levels
Denkowski & Denkowski	1984	School (specifics N/A)	45 (2)	N/A	Brain wave biofeedback, progressive relaxation	Reading achievement, disruptive behavior, impulse control, conduct self-efficacy	Group	Overall, no significant differences among treatment and control groups; EMG biofeedback and progressive relaxation training resulted in a nonsignificant trend toward improvements in academic achievement and disruptive behavior; progressive relaxation training resulted in a significant shift toward internal locus of control
Denkowski, Denkowski, & Omizo	1983 *	Specially equipped treatment room in school	48	12 11-14	EMG (muscle tension) biofeedback, relaxation training	Math and reading achievement, academic and conduct self-efficacy, and self-esteem	Group	EMG biofeedback plus relaxation training improved reading and language performance, decreased muscle tension, and internally shifted locus of control; but did not affect mathematics performance or self-esteem
Dunn & Howell	1982 *	Laboratory	10	-- 6-12	EMG (muscle tension) biofeedback, relaxation training	Sustained attention, on-task behavior, activity level, muscle tension	Group	EMG biofeedback, muscle relaxation training, and a combination of both all resulted in improved behavior and performance and in reduced muscle tension

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Figure 7 (continued)

Studies Using BIOFEEDBACK as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Hampstead	1979	Laboratory	12	8 6-9	EMG (muscle tension) biofeedback	Activity level, general conduct, muscle tension	Single-subject	EMG biofeedback yielded visual motor gains, decreased muscle tension, and behavioral improvements in home
Hughes, Henry, & Hughes	1980	Treatment facility or clinic	3	8 6-10	Positive reinforcement, brain wave biofeedback	On-task behavior, activity level, EMG levels, general home behavior	Single-subject	Brain wave biofeedback with positive reinforcement effective in increasing on-task behavior and decreasing activity level during academic task
Lubar & Lubar	1984 *	Treatment facility or clinic	6	12 10-19	Brain wave biofeedback, academic training	Math, reading, social studies, and science achievement, general information	Case study	Brain wave biofeedback training combined with academic training improved academic performance, and led to desired changes in brain wave activity
Lubar & Shouse	1976	Laboratory	1	11 --	Methylphenidate, brain wave biofeedback	Sustained attention, on-task behavior, activity level, compliance, social skills	Single-subject	Brain wave biofeedback plus methylphenidate decreased activity level and distractibility, and increased compliance and productivity more than did methylphenidate alone
Rivera & Omizo	1980	Treatment room in school	36	9 7-11	EMG (muscle tension) biofeedback, relaxation training	Time on-task, visual discrimination	Group	EMG biofeedback plus relaxation training increased attention to task and decreased impulsivity
Schulman, Stevens, Suran, Kupst, & Naughton	1978	Treatment facility or clinic	1	11 --	Positive reinforcement, motor activity biofeedback	Activity level	Single-subject	Motor activity biofeedback plus positive reinforcement decreased activity level
Shouse & Lubar	1979 *	Laboratory, regular classroom	4 (1)	N/A	Methylphenidate, brain wave biofeedback	Sustained attention, activity level, disruptive behavior, compliance, aggression, social skills, SMR brain waves	Single subject	Brain wave biofeedback training increased production of motor inhibitors, as did methylphenidate

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Figure 7 (continued)

Studies Using BIOFEEDBACK as an Intervention for Children with ADD

Authors	Year — Annotated[1]	Setting	No. of ADD Ss[2]	Age (All Ss) Mean / Range	Factors Studied	Outcome Measures	Study Design	Relevant Findings
Tansey & Bruner	1983	Treatment facility or clinic	1	10 --	Brain wave and autonomic responses biofeedback	Reading task, sustained attention, activity level, impulse control	Case study	EMG biofeedback decreased muscle tension, activity level, and impulsivity, and increased sustained attention, frustration tolerance, and reading skills

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[2] Includes subjects with an attention deficit diagnosis and subjects with ADD characteristics; numbers in ( ) represent attrition.

ANNOTATED BIBLIOGRAPHY

Abikoff, H.A., & Gittelman, R. (1985). Hyperactive children treated with stimulants: Is cognitive training a useful adjunct? *Archives of General Psychiatry, 42,* 953-961.

Abikoff and Gittelman used multiple outcome measures to study the effectiveness of a cognitive-behavioral training program and methylphenidate. Subjects were children between the ages of 6 and 12 whom the authors determined needed continued psychostimulant therapy because of hyperactivity. The researchers randomly assigned the 50 subjects to three treatment groups: cognitive training, attention control, or medication only. All subjects received maintenance dosages of stimulants during the 16 week intervention period. The subjects in the cognitive training group received 16 weeks of training in problem-solving techniques and verbal control of impulsive responding. A large component of this training consisted of the trainers modeling self-verbalizations including statements of self-evaluation and statements describing future actions. During the last 8 weeks, the subjects practiced social problem-solving. The subjects in the attention control group received the same number of therapy sessions and the same exposure to materials as the subjects who received cognitive-behavioral training, but the attention control subjects did not receive direct instruction in problem-solving techniques. A third group received no training.

At posttest there were no differences between groups on measures of classroom behavior, except that teachers rated medication-only subjects as significantly less distractable than the subjects who received attention control treatment. The researchers found no significant differences between treatment groups on measures of home behavior or academic achievement. Following posttesting, the researchers placed subjects on placebo therapy (without parents' or teachers' knowledge). At follow-up testing on placebo, the subjects who had been in the medication-only group were less disruptive (by teacher ratings) and less impulsive (by parent ratings) than either the cognitive-training or the attention control groups. Teachers and parents indicated no other treatment differences. Abikoff and Gittelman suggested that the dearth of behavioral gains through cognitive training indicated the failure of the effects of this technique to generalize beyond the training setting.

Abikoff, H., & Pollack, E. (1983, August). *Cognitive training in academic skills with stimulant treated hyperactive children: A pilot study.* Paper based in part on a poster session presented at the meeting of the American Psychological Association, Anaheim, CA.

Abikoff and Pollack studied the effects of a cognitive training program on academic performance. Subjects were 12 boys with hyperactivity at a child outpatient research clinic, all of whom were receiving methylphenidate treatment. For 10 weeks, Abikoff and Pollack conducted individualized cognitive training sessions for the subjects twice weekly. Sessions included training in self-monitoring and self-reinforcement of self-instructional

problem-solving behaviors, correspondence training, and the use of academic tasks and materials.

Standardized reading and mathematics achievement tests and a researcher-developed academic skills test served as measures of academic performance. Prior to cognitive training, the researchers administered the achievement tests with the subjects on placebo. They then reinstated the boys' medication, administered the academic skills test, and began cognitive training. At the end of the 10-week training period, the researchers readministered all performance measures with the subjects on medication. At pretest and posttest, the researchers also administered the academic skills test to a quasi-comparison group, which consisted of an unspecified number of hyperactive boys treated with methylphenidate only.

At posttest, trained subjects showed significant improvement on the reading but not on the math achievement tests. Trained subjects, but not comparison subjects, also showed significant improvement on the academic skills test. Although Abikoff and Pollack administered the achievement tests under differing medication conditions at pre and posttest, they noted that previous studies have shown methylphenidate to have little effect on academic performance. Additionally, they contended that the trained subjects' improvement on the non-standardized academic skills test (with pre and posttesting both done with methylphenidate) suggested that the change in drug state was not the only reason for improved performance on the achievement tests.

Abramowitz, A.J., Eckstrand, D., O'Leary, S.G., & Dulcan, M.K. (1992). ADHD children's responses to stimulant medication and two intensities of a behavioral intervention. *Behavior Modification, 16,* 193-203.

Abramowitz and her colleagues investigated the effects of low, moderate, and placebo methylphenidate doses in combination with two intensities of teacher reprimands. They exposed subjects with attention-deficit hyperactivity disorder (ADHD) to each of six possible combinations of methylphenidate dose and reprimand "intensity" (defined by the timing of the reprimand). The researchers speculated that some children would function well on the lower dose or without methylphenidate if they received immediate reprimands, and some children would function well with delayed reprimands if they received higher doses of medication.

The researchers chose as subjects 3 boys, ages 10 and 11, with average cognitive abilities. In a summer day treatment program, a certified special education teacher provided the behavioral interventions. These interventions consisted of two levels of reprimands (statements of disapproval in which the teacher identified inappropriate behaviors to be stopped, appropriate behaviors to be resumed, or both). In the immediate-reprimand condition, the teacher delivered reprimands as quickly as possible following the onset of off-task behavior. In the delayed-reprimand condition, the teacher delivered reprimands approximately 1 minute following onset of off-task behavior. If subjects did not respond,

the teacher repeated the reprimands after 5 to 10 seconds in the immediate-reprimand condition and after 1 minute in the delayed-reprimand condition.

On measures of off-task behavior, the subjects responded differently across the conditions. All three were off-task most during the delayed-reprimand/placebo condition, but optimal conditions varied for each. One subject performed best when he received the higher dose of medication, regardless of the reprimand level. Another subject performed equally well under high or low medication combined with either reprimand level. The third subject performed as well under the immediate-reprimand/placebo condition as he did under high medication. According to the researchers, the results suggest that a simple behavioral intervention can be as effective as medication for some children with ADHD. On the other hand, for some children, medication can obviate the need for intense behavioral intervention. The authors concluded that, in response to pharmacotherapy and behavior therapy, individual differences appear to be the rule.

Abramowitz, A.J., & O'Leary, S.G. (1990). Effectiveness of delayed punishment in an applied setting. ***Behavior Therapy, 21***, 231-239.

Using a single-subject design, Abramowitz and O'Leary examined the effects of immediate and delayed reprimands delivered contingently for off-task behavior. Subjects were 4 first- and second-grade boys who exhibited high rates of off-task behavior in a laboratory school classroom for hyperactive children. The students had been referred to the laboratory class by their regular classroom teachers and had scored at least 2 standard deviations above the mean on the hyperactivity factor of a teacher rating scale. The researchers defined a reprimand as a statement designed to halt inappropriate behavior. They instructed the boys' teacher to reprimand off-task behavior during seatwork in one of two ways: immediately on occurrence of off-task behavior (immediate-reprimand condition) or after 2 minutes of continuous off-task behavior (delayed-reprimand condition).

Immediate reprimands yielded much lower rates of interactive off-task behavior (any behavior that involved two or more children attending to one another) than did delayed reprimands, but reprimand timing did not affect rates of noninteractive off-task behavior (any behavior neither appropriate to the task nor categorized as interactive). The researchers suggested that high interactive off-task rates during the delayed reprimand condition may have occurred because reinforcement of off-task behavior by classmates competes with teacher reprimands. They found the results involving noninteractive off-task behavior more difficult to interpret. They noted the likely presence of reinforcers in both reprimand levels, but also suggested that the noninteractive off-task behaviors may have been avoidance or escape responses, which have been shown to be unresponsive to punishment. Whatever the case, they concluded that for noninteractive off-task behaviors, reprimands do not serve as punishers, and that timing is less important and perhaps inconsequential in their management. Because immediate reprimands resulted in much lower rates of interactive off-task behavior, they recommended that, for reprimands to be

effective, teachers should attempt to reprimand interactive off-task behavior as soon as it occurs.

Abramowitz, A.J., O'Leary, S.G., & Futtersak, M.W. (1988). The relative impact of long and short reprimands on children's off-task behavior in the classroom. *Behavior Therapy, 19,* 243-247.

This study examined the relative effectiveness of reprimands of varying lengths. The subjects were 7 hyperactive second- and third-grade boys attending a special education laboratory school. They had been referred to the school by their regular classroom teachers who gave them high ratings on a scale of hyperactivity and reported that the children exhibited extreme impulsivity and inattention.

Using a single-subject, alternating-treatments design, the researchers compared the effects of long and short teacher reprimands on children's off-task behavior during seatwork sessions. They defined "long" as two or more phrases, "medium" as one phrase (data for medium reprimands were not included in the analysis), and "short" as no more than two words in addition to a child's name. With frequencies of praise and reprimands controlled, short reprimands resulted in significantly lower rates of off-task behavior than did long reprimands. There was a similar trend, though not statistically significant, in regard to improvement of academic performance.

The authors conjectured that long reprimands were less effective in reducing off-task behavior because long reprimands involve more adult attention, which may serve as a positive reinforcer. They noted that the reprimands studied not only differed in length, but also differed in content and amount of information. Long reprimands included a disapproval statement, a phrase regarding the desired behavior, and a contingency statement. Though this type of information should prove beneficial to students, the authors suggested that the children may have already been familiar with the information in the long reprimands because classroom rules and expectations were clearly established.

Abramowitz, A.J., O'Leary, S.G., & Rosén, L.A. (1987). Reducing off-task behavior in the classroom: A comparison of encouragement and reprimands. *Journal of Abnormal Child Psychology, 15,* 155-163.

In two related experiments, the researchers examined the effects of teacher encouragement compared to either no feedback or reprimands in reducing students' off-task behavior. The subjects were 16 children, ages 7 to 9 years, attending a remedial summer treatment program at their parents' request. The children, whose teachers had completed a teachers rating scale and an academic questionnaire, were identified as having academic or behavioral problems. Of the 16 students, 6 scored high on the daydreaming/inattention scale and 5 scored high on the hyperactivity scale. An equal number of children (8) attended either morning or afternoon sessions according to parent preference. The teacher

who taught both sessions implemented three conditions: no feedback, encouragement, and reprimand.

For the first experiment, while working in a reading group with 2 or 3 students, the teacher scanned the 5 or 6 students working independently on math problems and gave no feedback, encouraging statements, or reprimands. Independent observers counted off-task behaviors at continuous 10-second intervals, while the number of problems completed correctly in 5 minutes served as the academic performance measure. Students' off-task behavior revealed no significant differences between the encouragement and no-feedback conditions, while students showed significantly lower off-task rates with reprimands than with no feedback. Six of 8 children completed more problems correctly during the encouragement condition, compared to the no-feedback condition. No differences were noted in comparisons of the children's academic performance under the reprimand condition versus the no-feedback condition.

The second experiment was identical to the first except the researchers directly compared the effects of teacher encouragement to reprimands. Thirteen of 16 children were off-task less in the reprimand condition. The mean number of correct math problems was greater in the reprimand condition. According to the authors, the results are consistent with other research that has found that teachers use reprimands frequently and effectively in reducing off-task behavior. The effect of encouragement was inconclusive. The researchers postulated that encouragement may be more effective if used to support on-task behavior.

Ayllon, T., Layman, D., & Kandel, H.J. (1975). A behavioral-educational alternative to drug control of hyperactive children. ***Journal of Applied Behavior Analysis, 8,*** 137-146.

Ayllon and his colleagues used a single-subject design to determine the effectiveness of behavioral techniques relative to drug therapy in controlling disruptive behavior and in enhancing academic performance. The subjects were 3 hyperactive children between the ages of 8 and 10 who were enrolled in a learning disabilities class. All children took methylphenidate to control their hyperactivity.

The researchers established baselines of activity level as well as reading and math performance for each subject both on and off of medication. They began with a 6-day intervention of a token reinforcement system where the subjects received points for correct responses in math. During the next 6 days, the subjects received points for performance in both reading and math. The results indicated that, although the subjects' hyperactivity increased dramatically following the discontinuation of methylphenidate, the institution of the token economy caused the hyperactivity to drop to levels comparable to the levels achieved with methylphenidate. The results also indicated that, in contrast to the subjects' performance while taking methylphenidate, the establishment of the token economy led to dramatic improvements in academic performance.

Barkley, R.A., Guevremont, D.C., Anastopoulos, A.D., & Fletcher, K.E. (1992). A comparison of three family therapy programs for treating family conflicts in adolescents with attention-deficit hyperactivity disorder. *Journal of Consulting and Clinical Psychology, 60*, 450-462.

In this study, Barkley and his colleagues compared the effectiveness of three different family therapy approaches for adolescents with ADHD and their parents. The subjects were 64 adolescents between the ages of 12 and 17 who met the DSM-III-R criteria for ADHD. The researchers randomly assigned subjects and their mothers to one of three treatment groups. The mothers assigned to the first treatment group underwent training in child behavior management techniques such as positive reinforcement, token economies, and non-punitive punishment. The children were not active participants in this treatment. Both mothers and children participated in the second treatment condition, "problem solving and communication training." For this treatment, the therapists instructed the subjects in problem-solving techniques, effective communication, and belief restructuring. A third group of mothers and children participated in "structural family therapy" in which they learned to identify and rectify maladaptive interaction processes.

Analyses at pretest, posttest, and 1-year follow-up indicated that, according to mother and adolescent reports, all treatments produced improvements in communication, conflicts, anger intensity, and school adjustment. While the subjects' self-reports indicated these improvements, clinical measures of the same variables showed only slight improvements with no significant differences among the three treatment groups. The authors concluded that this research confirms other reports that most hyperactive or aggressive children need long-term, multimodal interventions as opposed to short-term therapy approaches. Nevertheless, they suggested that the family therapies researched here might be useful even if only to help adolescents and their families cope with the disorder.

Bloomquist, M.L., August, G.J., & Ostrander, R. (1991). Effects of a school-based cognitive-behavior intervention for ADHD children. *Journal of Abnormal Child Psychology, 19*, 591-605.

Bloomquist, August, and Ostrander assessed the short-term efficacy of multicomponent cognitive-behavioral therapy (CBT) and teacher-only CBT. Subjects were previously undiagnosed elementary (grades 1-4) students, from 3 suburban schools, who underwent the researchers' three-stage screening process for ADHD. Two of the 3 participating schools were randomly selected to receive both the multicomponent and teacher-only CBT with the third school serving as the no-treatment control. The multicomponent CBT included (a) a child component during which the school psychologist and trained psychology students conducted group therapy with 6 to 8 ADHD students for 10 weeks on problem-solving skills; (b) a teacher component consisting of one 2-hour inservice and six hour-long consultations over a 20-week period, during which teachers learned about ADHD, how to teach problem-solving and behavior management techniques; and (c) a parent component consisting of seven 90-minute sessions that provided education about

ADHD, parental support, and training on behavioral management techniques. The teacher-only CBT consisted of the teacher component of the multicomponent intervention.

Measures included classroom observations by independent observers, two teacher scales, and two student self-report scales. The final student sample sizes were 11 for the multicomponent intervention, 12 for the teacher-only intervention, and 13 for the control group. The groups did not differ on any of the pre-intervention measures. Post-intervention, greater reduction by the multicomponent group in off-task/disruptive behavior provided the only significant difference. No other post-intervention differences were found based on teacher or student reports. At the six-week follow-up, the researchers found no significant differences among the two treatment groups and the control group. The researchers concluded that the results provide "minimal support for the efficacy of a school-based, multicomponent CBT intervention," and that less time-consuming and labor-intensive behavioral interventions could achieve similar results. They did, however, point to study procedures that may have limited the findings, and they suggested that the study resulted in sufficient positive anecdotal information to recommend future research.

Borden, K.A., Brown, R.T., Wynne, M.E., & Schleser, R. (1987). Piagetian conservation and response to cognitive therapy in attention deficit disordered children. *Journal of Child Psychology and Psychiatry, 28,* 755-764.

Citing research that shows inconsistent results regarding cognitive therapy, and research that shows the importance of considering the match between children's cognitive capacities and the requirements of training tasks, Borden and her colleagues examined the influence of cognitive development level on the ability of children to benefit from cognitive therapy. Specifically, they investigated whether cognitive development level, derived from basic Piagetian conservation tasks, mediated the outcome of cognitive therapy for a group of 25 boys and 4 girls clinically diagnosed with ADD with hyperactivity (76%) or ADD without hyperactivity (24%). Their ages ranged from 6 to 12.

The researchers determined the subjects' developmental levels according to their performances on conservation-of-number and conservation-of-substance tasks. Assessment by these tasks produced three groups of children: conservers, nonconservers, and transitional conservers. Each subject attended 22 one-hour cognitive strategy sessions, held twice a week for three months and conducted with individual children by graduate students in psychology. The initial six sessions used modeling and faded rehearsal to train strategies for improving performance on laboratory tasks of attention. The next six sessions focused on specific and general strategies for academic tasks; and the next six used imagery, role playing, and verbal rehearsal with a focus on solving social problems in the classroom, with peers, and at home. The final four sessions targeted metacognitive skills to initiate a recognition of causal relationships between behavior and environmental consequences and to develop a general strategy for solving novel tasks.

Contrary to the hypothesis, pre and post measures of sustained attention, distractibility, academic achievement, and academic aptitude, and behavioral ratings of teachers and parents, produced no statistically significant differences across the three developmental groups. Only on cognitive impulsivity did the researchers find significant group differences, but these favored the nonconserving group, which showed greater gains following cognitive training than did the conserving or transitional groups. Despite the lack of supporting empirical data, Borden and her colleagues concluded that their findings "lend some support" to the hypothesis that the success of cognitive training is related to the child's ability to conserve. They maintained that the training they provided may have been too basic for the more developmentally advanced groups, thus addressing skills they had already acquired. They inferred, therefore, a mediating effect of developmental level whereby the nonconservers benefitted from the concrete cognitive therapy while the more advanced subjects had little to gain.

Braud, L.W. (1978). The effects of frontal EMG biofeedback and progressive relaxation upon hyperactivity and its behavioral concomitants. *Biofeedback and Self-Regulation, 3,* 69-89.

Braud conducted this study to determine whether electromyographic (EMG) biofeedback or progressive relaxation therapy can effectively reduce muscle tension, alleviate problem behaviors of hyperactive children, and improve their intellectual performance. Braud's subjects were 30 children, half of whom were clinically diagnosed as hyperactive (12 boys and 3 girls, ages 6 to 13). Braud randomly assigned the subjects to three conditions: biofeedback, progressive relaxation, and no-treatment control. Six of the children were also on medication for hyperactivity during the study. In a laboratory setting, subjects in the biofeedback condition received 12 EMG biofeedback training sessions in which they attempted to lower overall body tension. Electrodes on their foreheads measured tension levels and, through a visual feedback system, the trainer gradually shaped deep muscular relaxation. Children in the progressive relaxation condition participated in 12 audio-tape training sessions in which they performed systematic exercises involving alternate tensing and relaxing of all muscle groups.

Both EMG biofeedback and progressive relaxation exercises significantly reduced EMG-defined muscular tension and problem behaviors in hyperactive children, with biofeedback proving superior in decreasing muscle tension. For both techniques, the greatest behavioral benefits were in aggression and emotionality (i.e., irritability, explosiveness, impulsivity, and low frustration tolerance). The cognitive test scores of hyperactive subjects also improved under both treatments. Medicated and non-medicated subjects equally reduced tension levels, but non-medicated children made greater behavioral gains. To Braud, the results clearly indicated that both EMG biofeedback and relaxation training can reduce muscle tension. He asserted, however, that progressive relaxation training is easier, less expensive, and more practical because no equipment is necessary and skills may better generalize to multiple situations and settings. On the other hand, he pointed out that biofeedback equipment can objectify tension levels and may result in quicker

training. Braud suggested that, for more effective intervention using either method, the duration of training should be extended from the 6 weeks he used to 10 or 12 weeks. He also recommended weekly meetings with parents and children to discuss applications for home and school, as well as mental relaxation and concentration exercises to further improve mental self-control.

Braud, L.W., Lupin, M.N., & Braud, W.G. (1975). The use of electromyographic biofeedback in the control of hyperactivity. *Journal of Learning Disabilities, 8,* 21-26.

The researchers examined the effectiveness of electromyographic (EMG) feedback in reducing the muscular activity and muscle tension of a 6-year-old boy who, based upon behavioral observations, was considered hyperactive. In biofeedback laboratory sessions, the boy received 8 weeks of EMG biofeedback training during which, by sitting still and relaxing, he learned to turn off a tone that signaled the presence of muscular tension. The researchers sounded the tone when the boy's muscle tension, measured by electrodes placed on his forehead, exceeded a pre-set threshold value. To facilitate generalization, during weeks 5 through 8, the researchers asked the boy's teacher and mother to encourage and supervise his practice sessions at school and at home.

As a result of biofeedback training, the boy's muscular tension and activity levels decreased. He learned to control problem behaviors and, at a 7-month follow-up, maintained that ability. When he practiced the techniques at home and at school his behavior in those settings improved. His mother and teacher reported calming effects for up to 24 hours after laboratory training sessions and for several hours after home and school practice sessions. He gained on measures of cognition and academic achievement and, based upon researcher observations, his self-confidence and self-concept improved.

Brown, R.T., Borden, K.A., Wynne, M.E., Schleser, R., & Clingerman, S.R. (1986). Methylphenidate and cognitive therapy with ADD children: A methodological reconsideration. *Journal of Abnormal Child Psychology, 14,* 481-497.

The researchers studied the effects of methylphenidate, cognitive therapy, and a combination of the two on children with ADD. Subjects were 28 boys and 7 girls, ages 5 to 13. The majority were clinically diagnosed as having ADD with hyperactivity. The others were diagnosed as having ADD without hyperactivity. In a laboratory setting, the researchers randomly assigned the subjects to four treatment conditions: cognitive training with methylphenidate, no training with methylphenidate, cognitive training with placebo, and no training with placebo. In contrast to their previous study (Brown, Wynne, & Medenis, 1985), in which methylphenidate treatment continued after the termination of cognitive therapy, the researchers did not administer medication during posttesting. According to the authors, for the previous study there was no statistical procedure to adequately address a combined treatment program in which half of the treatment is discontinued. In the present study, the researchers had completed all treatments at

posttesting. Also, in this study the researchers used a placebo condition and randomly assigned subjects to all groups, rather than using a waiting-list control group as they had done previously.

Subjects in the methylphenidate conditions received individualized dosages. In cognitive training, subjects attended 22 cognitive strategy sessions, on an individual basis, for 3 months. Trainers taught social problem-solving techniques and specific and general strategies regarding laboratory attention tasks and academic work. They targeted metacognitive skills and stressed the importance of planning. The researchers compared the treatment groups on measures of sustained attention and cognitive style, tests of academic achievement, and ratings of behavior. After analyzing the data, they found no significant main treatment effects or interactions. They noted that, after termination of drug therapy, the measurable effects of methylphenidate dissipated rapidly such that performance was no better than before drug therapy. They also determined that the combination of methylphenidate and cognitive therapy was no more effective than either of the treatments alone.

The researchers offered several possible explanations for their results. They suggested that a behavioral "rebound effect" may have caused the rapid decrease in medication effects, and that continuous medication may be necessary to sustain improvement. They surmised that the children in this study were not cognitively advanced enough to benefit from the training. They suggested also that the parameters they used to define cognitive training may have been at fault, and that other combinations and variations might prove beneficial. Even with the discouraging results, the researchers found the findings intriguing when compared to the results of their previous study in which methylphenidate appeared to be an unconditionally effective treatment. The authors concluded that the differing results were due to study designs that determined presence versus absence of medication at posttest. Consequently, they emphasized that researchers must precisely and explicitly describe their procedures because seemingly minor variations in methodology can dramatically affect results.

Brown, R.T., Wynne, M.E., Borden, K.A., Clingerman, S.R., Geniesse, R., & Spunt, A.L. (1986). Methylphenidate and cognitive therapy in children with attention deficit disorder: A double-blind trial. *Developmental and Behavioral Pediatrics*, 7, 163-170.

Brown and his colleagues examined the effectiveness of cognitive therapy in facilitating the maintenance of improvements of ADD symptoms in children using methylphenidate. The subjects for this study were 40 boys and girls between the ages of 5 and 13 who had been referred to an outpatient clinic by schools and physicians. After undergoing stringent diagnostic procedures, all subjects met the DSM-III criteria for ADD with or without hyperactivity. Researchers randomly assigned the subjects to one of four treatment groups: methylphenidate/cognitive therapy, methylphenidate/therapy control, placebo/cognitive therapy, or placebo/therapy control.

Subjects assigned to the methylphenidate groups received individually titrated dosages twice per day. To determine long-term, posttreatment effects of methylphenidate, the medication was discontinued after the treatment interventions and prior to posttest and follow-up testing. Subjects receiving cognitive behavioral self-control training participated in 22 one-hour sessions aimed at teaching the subjects strategies to solve cognitive problems and to develop a more systematized approach to problem solving. Subjects in the therapy control group also received 22 one-hour therapy sessions, but the trainers did not teach problem-solving techniques.

Pretest, posttest, and follow-up measures of achievement, impulsivity, attention, self-control, hyperactivity, and social skills failed to show significant gains for any group or differences among the treatment groups. The researchers suggested that the surprising failure of the methylphenidate groups to show significant improvement on cognitive and behavioral measures at posttest could be due to the medication being discontinued during the week of the posttest. The placebo/cognitive therapy group showed improvement in impulsivity, but those gains were not statistically significant. The researchers concluded that cognitive therapy has a "very circumscribed effect" that is primarily evident on laboratory tasks. They found no evidence that cognitive therapy facilitates the maintenance of the positive effects of methylphenidate.

Brown, R.T., Wynne, M.E., & Medenis, R. (1985). Methylphenidate and cognitive therapy: A comparison of treatment approaches with hyperactive boys. ***Journal of Abnormal Child Psychology, 13,*** 69-87.

In this study, Brown, Wynne, and Medenis compared the effects of three interventions with 40 hyperactive boys, ages 6 to 11. According to parent and teacher reports, each boy had experienced academic difficulties and had demonstrated serious and persistent symptoms associated with attention deficit disorder with hyperactivity (ADDH). In a laboratory-type setting, the researchers randomly assigned 30 boys to one of three treatment groups: methylphenidate therapy, cognitive training, and methylphenidate combined with cognitive training. Rather than randomly assigning subjects to a no-treatment control group, the researchers enlisted 10 other hyperactive boys from a clinic waiting list. There was no placebo control group.

The researchers implemented the interventions over a 3-month period. Cognitive training lasted 12 weeks, and the researchers not only worked directly with the boys, but also instructed the boys' parents and teachers to apply cognitive training procedures at home and in the classroom. The goal was to train each boy to evaluate his own performance and to cope more effectively and independently with problems. The training sessions included modeling, self-verbalization, strategy training, and problem-solving skills training. To promote generalization, trainers encouraged the boys to use the strategies in both academic and social situations.

The researchers administered measures of sustained attention and cognitive impulsivity, tests of academic achievement, and teacher and parent behavioral ratings. Only the boys in the two medication conditions demonstrated significant improvement in sustained attention and behavior. Medication combined with cognitive training was no more effective than medication alone. Cognitive training alone improved sustained attention, though not significantly, and did not improve behavioral ratings. For all treatments, there was no significant improvement on academic measures. The authors concluded that medication may be a necessary adjunct to alternative therapies. They suggested that because methylphenidate has been repeatedly shown effective, future research should focus on medication's ability to strengthen behavioral, cognitive, and psychotherapeutic interventions for hyperactive children.

Chase, S.N., & Clement, P.W. (1985). Effects of self-reinforcement and stimulants on academic performance in children with attention deficit disorder. *Journal of Clinical Child Psychology, 14,* 323-333.

Chase and Clement compared the academic performance effects of methylphenidate and self-reinforcement, alone and in combination. Their subjects were 6 boys, ages 9 to 12 years, who had been clinically diagnosed with ADDH. The research setting was a classroom within a laboratory school for children with emotional and educational disabilities.

In a series of single-subject studies, each subject, after a 2-week baseline period and across seven treatment phases, received methylphenidate (with noncontingent token reinforcement), self-reinforcement with placebo, and self-reinforcement with methylphenidate. In the self-reinforcement condition, each subject developed a weekly contract with the teacher, which listed the subject's self-determined reading assignment goals for each day of the week. During daily tutoring sessions the subject monitored his performance and recorded points for the assigned items he completed. At the end of each session, the subject and teacher jointly determined if the subject met contract goals. The subject later traded his points for backup reinforcers. In the methylphenidate (with noncontingent token reinforcement) condition, at the end of each session and regardless of performance, subjects received the same number of points earned by children in the self-reinforcement condition, but they were not told how the number of points was determined.

Methylphenidate alone did not improve academic performance (task accuracy and number of items completed). Self-reinforcement improved academic performance somewhat, and the two treatments combined greatly improved performance. Chase and Clement concluded that for improving the academic performance of children with ADDH, the combination of the two treatments is most effective, self-reinforcement is next, and methylphenidate is least effective.

Cohen, N.J., Sullivan, J., Minde, K., Novak, C., & Helwig, C. (1981). Evaluation of the relative effectiveness of methylphenidate and cognitive behavior modification in the treatment of kindergarten-aged hyperactive children. *Journal of Abnormal Child Psychology, 9,* 43-54.

The purpose of this investigation was to assess the effectiveness of a cognitive behavior modification program and methylphenidate in a kindergarten population. The experimental subjects included 24 hyperactive kindergarten children (21 of whom were male) identified by their teachers and parents and screened by the researchers for inclusion in the research.

The researchers randomly assigned subjects to one of four treatment groups: cognitive behavior modification, methylphenidate, both treatments, or no treatment. Children who received methylphenidate received individually titrated dosages. Children who received the cognitive behavior modification treatment participated in 20 one-hour training sessions directed at improving their problem-solving and evaluative skills. Teachers and parents were aware of the cognitive intervention and knew to practice techniques with children at school and at home.

The researchers administered global cognitive and behavioral measures at posttest and at a follow-up of one year. The results indicated no significant differences between the four treatment groups. The authors concluded that their findings confirm previous research indicating that methylphenidate tends to be less effective in preschoolers than in school-aged children. They also suggested that the failure of the cognitive behavior modification program to affect objective measures could be because of the subjects' immature cognitive development.

Conte, R., Kinsbourne, M., Swanson, J., Zirk, H., & Samuels, M. (1986). Presentation rate effects on paired associate learning by attention deficit disordered children. *Child Development, 57,* 681-687.

Conte and his colleagues compared two ways of varying presentation rate during paired associate learning. They used fixed-rate lists (stimuli presented at equal rates throughout a task) and mixed-rate lists (at random, half the items were presented at a fast rate and half at a slow rate). They divided the subjects, 24 boys and girls, ages 8 to 12 years, into three groups. Eight children made up the ADD with hyperactivity group, 8 were in the ADD without hyperactivity group, and 8 others were comparison subjects with no history of learning problems.

The researchers used three types of computerized paired associate lists: fixed-rate lists with either 6-second or 12-second trials, and mixed-rate lists with half of the trials at the 6-second rate and half at the 12-second rate. Lists consisted of 4, 6, 8, or 10 items with the number of items adjusted to subject ability as determined in practice trials. (List length was equal for the two attention deficit groups and longer for the comparison group.) According to the results, neither of the attention deficit groups showed a main effect for

rate, however, for the ADD without hyperactivity group, there was a significant interaction between rate and list such that slow-rate items on the mixed-rate lists improved performance, but slow-rate items on the fixed-rate lists hindered performance. For the ADD with hyperactivity group, there was a nonsignificant trend toward the same rate-by-list interaction.

Noting that both of the attention disordered groups benefited from additional presentation time in mixed-rate lists but not in fixed-rate lists, the researchers suggested that average event rate rather than individual item duration was the relevant variable. Specifically, children with attention deficits were vulnerable to the context in which items were presented at a consistently slow rate over an extended time period. They concluded that the regulation of behavior, for children with attention deficits, is sensitive to situational contexts.

Denkowski, K.M., Denkowski, G.C., & Omizo, M.M. (1983). The effects of EMG-assisted relaxation training on the academic performance, locus of control, and self-esteem of hyperactive boys. *Biofeedback and Self-Regulation, 8,* 363-375.

Denkowski, Denkowski, and Omizo examined the effects of electromyographic-assisted relaxation training on academic performance, locus of control, and self-esteem. Their subjects were 48 boys, ages 11 to 14 years, who were determined to be hyperactive based on teacher ratings. The researchers randomly assigned the subjects to experimental and control conditions. For members of the experimental group, a school psychologist conducted relaxation training during six 20- to 25-minute biweekly sessions using electromyographic (EMG) biofeedback and relaxation cassette tapes. A different school psychologist held the same number of biweekly sessions with members of the control group. Rather than the structured dialogue and training of the experimental condition, the psychologist administering the control condition engaged subjects in "small talk."

To assess treatment outcomes, the researchers administered pre and posttest measures of muscle tension, mathematics performance, reading and language performance, locus of control, and self-esteem. Results indicated that, compared to the control group, experimental group members demonstrated significantly higher reading and language (but not mathematics) performance gains. The experimental group showed an internal shift in locus of control, though self-esteem did not improve significantly. Also, muscle tension decreased for the experimental group but did not change for control subjects.

The researchers dismissed the possibility that personal characteristics of the two psychologists could have differentially affected outcomes, and they concluded that tension reduction obtained through EMG-assisted relaxation training can generalize to improve academic performance. They were uncertain as to why math performance did not improve for experimental subjects, and suggested that future studies incorporate measures to better distinguish between changes in existent skills versus new learning. They recommended

that EMG-assisted relaxation training be considered by those who develop treatment programs for children with hyperactivity.

Douglas, V.I., & Parry, P.A. (1983). Effects of reward on delayed reaction time task performance of hyperactive children. *Journal of Abnormal Child Psychology, 11,* 313-326.

Douglas and Parry examined the effects of both reward schedule and the withdrawal of reward on reaction time. They screened a group of elementary school children to find hyperactive subjects with extreme problems involving attention, persistence, and restlessness. They established a hyperactive group and a nonhyperactive comparison group, each with 30 boys and 3 girls. Children in both groups were randomly assigned to one of three reward schedules: continuous, partial, and noncontingent. In a laboratory setting, each child then performed a delayed-reaction-time task individually, with one examiner who delivered social praise according to the assigned reward schedule.

Under continuous and partial schedules, reward improved reaction time for the hyperactive group. Their reaction time slowed under noncontingent reward and improved when it was withdrawn. During extinction, their performance returned to baseline level. Reaction times of nonhyperactive children significantly improved with reward and became slower during extinction. Even so, their scores during extinction remained superior to baseline level. For the nonhyperactive group, all reward conditions reduced response variability, but for the hyperactive group, only continuous reward reduced response variability. Overall, for all subjects, continuous contingent reward improved mean reaction times and reduced variability.

The authors concluded that these results indicate hyperactive children are unusually sensitive to rewards. They suggested that the hyperactive group's significant decrease in response variability only in the continuous condition demonstrates that partial reward is less effective for hyperactive children. Further, they inferred from the results that inconsistent reward can impair the performance of hyperactive children.

Douglas, V.I., Parry, P., Marton, P., & Garson, C. (1976). Assessment of a cognitive training program for hyperactive children. *Journal of Abnormal Child Psychology, 4,* 389-410.

The researchers trained hyperactive boys to use self-verbalizations and self-reinforcement during cognitive tasks, academic problems, and social situations. Subjects were 29 boys, ages 6 to 10, whom the researchers determined were hyperactive. Eighteen received training and 11 made up the no-treatment control group, though the researchers did not report how they assigned subjects to the two conditions. Boys in the treatment group received training in a clinical setting during 24 sessions conducted over a 3-month period. At least 6 of the sessions involved consultation with the children's teachers, and a

minimum of 12 sessions included one or both of each boy's parents. During their sessions, parents and teachers received information regarding cognitive training procedures that they were to implement at home and at school. Although they also received a brief introduction to contingency management techniques, emphasis was on helping the children learn self-control, self-instruction, and self-reinforcement. The focus of the children's training in self-reinforcement and self-instruction was on helping them cope more effectively and independently with cognitive problems and social situations that require focused attention and organized planning.

Using a battery of tests, the researchers assessed the boys three times: prior to training, after the 3-month training period, and after an additional 3-month follow-up period. Because the trained group showed significantly greater improvement on several posttest and follow-up measures of impulsivity, aggression, coping strategies, and listening comprehension, the authors concluded that cognitive training is an effective intervention for hyperactive children. The authors found it surprising that no training effects showed on a teacher rating scale. They reasoned that the lack of a training effect on the hyperactivity scale may have been because their training affected internal thought processes and inner controls more than outwardly observable behaviors. The authors surmised that greater emphasis on contingency management techniques in combination with cognitive training may produce more positive changes, and they suggested evaluating intervention effects over extended periods of time.

Dubey, D.R., & Kaufman, K.F. (1978). Home management of hyperkinetic children. ***The Journal of Pediatrics, 93,*** 141-146.

Dubey and Kaufman studied the efficacy of behavior management implemented by parents in the home. Their report described six clinical programs and one controlled, experimental program, all of which they conducted at a children's treatment facility. Although they did not require formal diagnoses of hyperactivity for families to enter the clinical programs, 81% of the participating children had received a medical diagnosis of hyperkinesis. Children receiving medication when the programs began, remained on medication throughout the study. The children ranged in age from 3 to 18.

In the six clinical programs, parents attended 10-week workshops in which clinical psychologists and doctoral interns taught general principles of behavior management through readings, lectures, discussions, and homework projects. A total of 87 families participated, with the enrollment of individual workshops ranging from 8 to 22. Based on pre and posttreatment parent ratings, they found reductions in children's hyperactivity in four programs and reductions in problem severity in five programs. Because the absence of control groups prevented the collection of data concerning possible natural changes over time, the authors conducted an experimental study to more vigorously test the efficacy of the parent training.

In the experimental program, the researchers randomly assigned 26 parents of hyperactive children to either a behavior modification group or a control group. Nineteen parents assigned to behavior modification received training in one of two groups, while 7 parents served as the delayed-treatment control. The experimental behavior management workshops were identical to the clinical programs. On every primary outcome measure relating to hyperactivity and behavioral problems, the treatment group made significantly superior gains over the control group. The treatment group improved their problem severity ratings significantly more than the control group. The frequency of problem behaviors decreased for the treated group but slightly increased for the control group. Based on the results of their clinical and experimental programs, Dubey and Kaufman concluded that parent training is a useful adjunct to other interventions for hyperactive children.

Dubey, D.R., O'Leary, S.G., & Kaufman, K.F (1983). Training parents of hyperactive children in child management: A comparative outcome study. *Journal of Abnormal Child Psychology, 11,* 229-246.

Dubey, O'Leary, and Kaufman compared parent behavioral training and Parent Effectiveness Training (PET) with parents whose hyperactive children exhibited problem behaviors in the home. The researchers recruited the parents through local newspapers. They selected 44 parents of 32 boys and 5 girls, ages 6 to 10, with high scores on a parent rating scale. The researchers assigned the parents to either behavior modification training, communication skills instruction (i.e., PET), or no-treatment control. Parents in the two treatment conditions attended group workshops; no one received individualized assistance.

Behavior modification training and PET took place separately during nine weekly, 2-hour sessions. Behavior modification training focused on general child management skills and the principles of learning. PET emphasized general skills of child management and parent-child communications. Thirty-two of the 44 families completed the training and pre/post assessments. Assessment measures included parent ratings of hyperactivity and severity of problems, a daily checklist of problem occurrence, a survey of parent attitudes, and direct observations in a laboratory setting.

Compared to the no-treatment control condition, both treatment methods proved effective in reducing hyperactivity, problem severity, and daily problem occurrence. Although both training models were beneficial, comparisons of the two treatments revealed that the behavior modification program effected more change than did PET on several measures. Parents who received behavior modification training rated their children as more improved than did PET parents. They were also more willing to recommend the training to friends with similar problems, more likely to feel the program was relevant to them, and were less likely to quit the program. Nonsignificant trends on hyperactivity ratings and global severity of problems also favored the behavior modification program. At a nine-month follow-up, improvements persisted for children whose parents had received either type of training.

The researchers concluded that, although training in behavior modification produced superior results, both educational methods effectively reduced the severity of hyperactivity and problem behaviors. They further contended that group training effectively improves parents' competence for handling their hyperactive childrens' problem behaviors. They surmised that the group training approach prevented dependence on the therapist, as can occur during individualized training and assistance, thereby resulting in maintenance of improvements nine months after parent training.

Dunn, F.M., & Howell, R.J. (1982). Relaxation training and its relationship to hyperactivity in boys. *Journal of Clinical Psychology, 38,* 92-100.

Dunn and Howell taught relaxation techniques to hyperactive boys by using electromyographic (EMG) biofeedback, progressive relaxation training (with relaxation tapes), and a combination of the two. They sought to determine whether hyperactive boys can learn to relax through training, and whether training affects their behavior and performance. Subjects were 10 hyperactive boys, ages 6 to 12, whom the researchers randomly assigned to one of the three relaxation-training conditions: EMG, relaxation tapes, or a combination. In a laboratory setting, the researchers first gave the boys 10 neutral treatment sessions followed by 10 relaxation-training sessions according to their assigned group. The neutral treatment, which served to measure placebo effect, consisted of relationship and play therapy, with a few restrictions on activity level.

Subjects made significant improvements on all behavior and performance outcome variables (including time on task, sustained attention, task accuracy, activity level, and cognitive test performance) with all three of the relaxation-training procedures. The results also indicated that all training techniques resulted in reduced muscle tension for all subjects. With relaxation tapes, subjects learned more quickly to relax, but as sessions continued, they did not relax as deeply as those who received EMG biofeedback. The researchers conjectured that relaxation tapes produced rapid learning because they require minimal mental exertion and attention, and because progressive relaxation is the natural result of tiring muscles by flexing. On the other hand, with biofeedback, the concentration needed to learn the body functions that cause muscle relaxation took longer to master but resulted in a greater ability to relax in the long term. The researchers concluded that muscle tension and the inability to relax contribute to and exaggerate the behavioral symptoms of hyperactivity, but that hyperactive boys can learn to relax using either EMG biofeedback, relaxation tapes, or a combination.

DuPaul, G.J., Guevremont, D.C., & Barkley, R.A. (1992). Behavioral treatment of attention-deficit hyperactivity disorder in the classroom: The use of the Attention Training System. *Behavior Modification, 16,* 204-225.

DuPaul and his colleagues investigated the effects of a response-cost program on the classroom behaviors of 2 boys diagnosed with ADHD and enrolled full-time in a self-

contained public school classroom for children with behavior disorders. (One subject was taking methylphenidate throughout the study.) The researchers implemented the response-cost program by using a commercially available electronic apparatus, placed on a child's desk, that displays cumulative points earned according to a fixed-interval reinforcement schedule. The apparatus automatically adds a point to the child's module display for each minute of on-task behavior. The teacher uses a remote control device to signal the child, and deduct a point, when off-task behavior occurs.

Using a reversal design with multiple baselines across academic work periods, the researchers studied the response-cost program alone and in conjunction with a directed-rehearsal procedure. Under the directed-rehearsal procedure, the teacher required a student to complete additional seatwork in the same academic subject area for 5 to 10 minutes immediately following any period during which he failed to earn at least 50% of the available points. On outcome measures that included direct observations of attention and activity level, assessments of academic productivity, and teacher ratings of behavior, the response-cost program alone and in combination with directed rehearsal resulted in improvements for both boys in on-task behavior, attention, product completion, and overall level of ADHD behavior (such as fidgeting and vocalizing). The response-cost intervention effects were replicated across two academic subjects (reading and language arts) for both boys.

The researchers concluded that the findings were ambiguous regarding whether the combination of response-cost and directed rehearsal provided additive benefits beyond response-cost alone. The classroom teacher and aide who participated in the study gave positive reports about the response-cost procedure. Specifically, they were pleased that, with the electronic apparatus, they did not have to manually dispense tokens, thus they could spend time working with small groups of children while maintaining response-cost procedures for an individual child.

Eastman, B.G., & Rasbury, W.C. (1981). Cognitive self-instruction for the control of impulsive classroom behavior: Ensuring the treatment package. *Journal of Abnormal Child Psychology, 9,* 381-387.

Eastman and Rasbury examined the effects of cognitive self-instruction training on the work habits and academic performance of 11 first-graders who were selected by their teachers because of their poor academic habits. They were also determined by teacher ratings to be hyperactive. The researchers assigned the subjects to two matched groups: treatment and control.

To the treatment group, Eastman and Rasbury administered individualized cognitive self-instruction training outside their classrooms for three daily 20-minute sessions. The researchers used academic assignments from the subjects' teachers as training materials. Following the out-of-class training periods, children returned to their classrooms where

their teachers provided prompts to use the skills they had learned in training and social reinforcement for using self-verbalizations during academic work.

Following training, there were no significant group increases in on-task behavior or in academic performance. Data for individual subjects in the treatment group were highly variable, however, with four of the six trained subjects showing a trend toward improvement. Because trends began to emerge for some of the treated subjects, the researchers surmised that children may need more time to practice and consolidate strategies before they can routinely use them effectively. They concluded that the length of training may have been too brief to facilitate optimal learning, thus preventing generalization to the classroom.

Erhardt, D., & Baker, B.L. (1990). The effects of behavioral parent training on families with young hyperactive children. *Journal of Behavior Therapy & Experimental Psychiatry, 21*, 121-132.

Erhardt and Baker described case studies of family-based behavioral interventions with 2 preschool boys diagnosed by their pediatricians as having ADHD. Mothers participated in a 10-week program designed to teach them to observe their children's behavior, identify strengths and behavior problems, implement effective behavior management programs, and reduce their own adverse reactions to the frustrations of living with hyperactive children. A clinical psychologist with extensive experience in parent training and a clinical psychology doctoral student served as the trainers. The training program consisted of two parts. In the first part, six 2-hour group meetings included didactic instruction, group discussions, role plays, and videotapes to instruct the mothers in a social-learning model of behavior so that parents would have a framework for conceptualizing and managing their children's behavior. The mothers learned to (a) operationalize a behavior problem, (b) take data, (c) identify relevant antecedents and consequences, and (d) develop, evaluate, and troubleshoot their own behavior management programs. The second part of the training comprised four 1-hour individual consultation sessions, during which the trainers helped the mothers tailor the general principals from the group meetings to their specific needs.

Based on follow-up interviews, rating scales, and data collected by parents, Erhardt and Baker reported "guarded optimism" based on "modest" gains attributable to the parent-training program. In both families, the mothers' knowledge of behavior modification principles and techniques improved, mothers increased confidence in their child management abilities, and targeted child behavior problems decreased. Additionally, the mothers saw improvements in the quality of parent-child interactions and developed more appreciative views of their children's positive qualities. The small magnitude or short duration of improvements in child noncompliance and the failure of treatment effects to generalize beyond targeted behavior problems limited the positive findings. The researchers concluded that parent training was insufficient to normalize the behavior of children with ADHD. In light of the limitations associated with other treatments for

preschool children with hyperactivity, however, they recommended further empirical investigations of parent-training programs, especially those that are longer-term or that are components of multifaceted treatment regimens.

Firestone, P., Crowe, D., Goodman, J.T., & McGrath, P. (1986). Vicissitudes of follow-up studies: Differential effects of parent training and stimulant medication with hyperactives. *American Journal of Orthopsychiatry, 56,* 184-194.

In a 2-year study, Firestone and his colleagues compared parent training and medication as interventions for children with attention deficits. Subjects were 134 families, with children ages 5 to 9 years, who were referred by physicians to a Canadian children's hospital because of hyperactivity. Hospital staff subsequently diagnosed the subjects as meeting criteria for ADDH. The researchers randomly assigned the children to three groups: parent training plus methylphenidate, parent training plus placebo, and methylphenidate only. Parent training included three individual therapy sessions, six group sessions, and two consultations with teachers. Subjects in medication groups received methylphenidate on school days only.

The researchers determined outcomes using measures of hyperactivity, general conduct, reaction time, and reading/language arts performance. At a 3-month posttest, all three groups showed improvement. There was no significant difference, however, between the methylphenidate-only and the parent-training-plus-methylphenidate groups, and both medication groups were significantly more improved (on all measures except reading/language arts) compared to the parent-training-plus-placebo group. At 1-year and 2-year follow-ups, the three groups largely maintained initial improvements.

The researchers concluded that, in the short-term, medication improves attention and behavior, with parent training adding little benefit. They acknowledged that high rates of subject attrition (only 54% carried through to posttest, and only 22% to 2-year follow-up) affected interpretations, and they recommended greater attention to dropout data in future studies.

Firestone, P., Kelly, M.J., Goodman, J.T., & Davey, J. (1981). Differential effects of parent training and stimulant medication with hyperactives. *Journal of the American Academy of Child Psychiatry, 20,* 135-147.

Firestone and his colleagues compared the effects of parent training in behavior management to the effects of methylphenidate on measures reflecting academic achievement, behavior, and emotional adjustment in children with ADD. Subjects were 79 children between the ages of 5 and 9 who met the DSM-III criteria for ADDH. The researchers randomly assigned subjects and their parents to a (a) parent-training-plus-placebo group, (b) parent-training-plus-methylphenidate group, or (c) methylphenidate-only group. Parent training in behavior management occurred in an outpatient

psychology clinic where parents participated in individual training sessions for approximately three sessions over five weeks. They read a book on child management and participated in group training for six sessions. During group training, they learned about specific behavior management techniques, communication with school staff, and development of home-school contracts.

Statistical analyses of pretest-posttest measures indicated that all three treatment groups made academic, behavioral, and emotional adjustment gains. The groups that received methylphenidate, however, made larger gains than the group that did not receive methylphenidate; and groups that received methylphenidate also showed improvement in attention and impulsivity. Additionally, parent training with methylphenidate did not produce benefits over methylphenidate alone.

The researchers concluded that the data do not support the strategy of using medication only as a last resort, but that stimulant medication may need to be the first intervention considered for hyperactive children in settings with personnel constraints. Other forms of treatment, including parent training, could then be provided when available or necessary. They suggested that the most effective intervention may be a combination of interventions (e.g., medication, parent training, and educational services). They noted that parent training is an affordable intervention when the goal is improved home and school behavior.

Flynn, N.M., & Rapoport, J.L. (1976). Hyperactivity in open and traditional classroom environments. ***Journal of Special Education, 10,*** 285-290.

Flynn and Rapoport proposed to determine the more appropriate classroom for hyperactive children in mainstream education: (a) open--with individualized instruction, free movement around the room, and teacher-child collaboration; or (b) traditional--with group instruction, limited movement, and teacher-directed experiences. Subjects were 30 boys, ages 7 to 12 years and clinically diagnosed as hyperactive, whom the researchers observed in 30 regular classes in a previous study of drug treatment. They observed 10 subjects in open classrooms, 13 subjects in traditional classrooms, and 7 in mixed classrooms. Most were also receiving stimulant medication.

At baseline and 1-year follow-up, the researchers observed each subject's classroom behavior on 2 days, for a total of 1 hour, and teachers rated hyperactive behaviors on a teacher rating scale. According to outcome measures (including reading and math achievement test scores and teacher reports on classroom performance), hyperactivity decreased for both groups, academic achievement improved equally well for both, and activity levels were equal.

Though there were no significant differences in behavioral or academic improvement, teachers of subjects in open classes perceived students as less disruptive than teachers of subjects in traditional classrooms. The researchers speculated that either the open

classroom subjects were less hyperactive than observation and teacher ratings indicated, or teachers were more tolerant of high activity levels in open classrooms. They concluded that further study is needed to determine if open classrooms are in fact preferable for hyperactive children.

Friedling, C., & O'Leary, S.G. (1979). Effects of self-instructional training on second- and third-grade hyperactive children: A failure to replicate. *Journal of Applied Behavior Analysis, 12*, 211-219.

Friedling and O'Leary conducted two experiments to investigate the effect of self-instructional training on hyperactive subjects' on-task behavior and performance on easy and difficult math and reading tasks. The subjects in the first experiment were 8 second- and third-grade children enrolled in a laboratory school. All 8 children rated as "clinically hyperactive" on teacher rating scales. The researchers divided the subjects into an experimental group and a control group and individually tutored each experimental subject for 90 minutes in self-instructional procedures focused on academic tasks. They also spent 90 minutes with each control subject, but only modeled task performance, and did not provide self-instructional techniques. The experimental subjects received two additional 40-minute training sessions using more difficult academic material. Following this second round of training, the children used bright orange labels as cues to use self-instruction. To assess the generalization of self-instructional skills to classroom performance, the researchers observed the subjects doing easy and difficult reading and math tasks in the classroom. Measures included time on task, accuracy of work, quantity of work (reading only), and teacher attention. The results indicated no significant treatment effect except for improved task accuracy by the experimental group on easy math problems following the initial training.

The researchers conducted the second experiment with the same subjects to determine if the subsequent implementation of a token economy would influence the subjects' on-task behaviors. This program caused an enormous increase in the amount of time on-task for both experimental and control subjects. The token economy did not, however, affect the subjects' task accuracy. Friedling and O'Leary concluded that their results did not extend those of an earlier laboratory study. They suggested that while self-instructional procedures may produce results in laboratory settings, the procedures will require adjustments before being useful in applied settings.

Futtersak, M.W. (1988). *The effects of consistently strong and increasingly strong reprimands in the classroom.* Unpublished doctoral dissertation, State University of New York at Stony Brook.

In this alternating treatment study, Futtersak examined the effects of reprimands on the classroom behavior of 20 first- through fourth-grade children enrolled in a summer remedial education program at a university laboratory school. Sixteen of the subjects

scored at least 2 standard deviations above the mean on one or more of the factors of a teacher rating scale, and all had academic deficits in reading or arithmetic. The research team dropped one classroom group of five children from the analysis because their disruptive behavior required behavior management conditions beyond those prescribed in the study procedures.

Futtersak compared the effectiveness of consistently strong verbal reprimands to reprimands that gradually increased in strength. He postulated that reprimands introduced and maintained in their most potent form would be more effective in reducing off-task behavior and improving academic performance than similarly strong reprimands introduced as the culmination of a series of less potent reprimand conditions. Results confirmed the hypothesis. The sudden introduction and maintenance of strong reprimands resulted in more overall suppression of unwanted behavior and reduced the overall level of negative consequences needed to control behavior in the classroom. Results also suggested that exposure to a gradually strengthening series of reprimands may lead to increased persistence in response to strong reprimands. Academic productivity was also highest during periods of consistently strong reprimands. Futtersak concluded that the gradual strengthening of mild punishment may result in less overall suppression of unwanted behavior, more frequent need for punishment, and more total punishment.

Gittelman, R., Abikoff, H., Pollack, E., Klein, D.F., Katz, S., & Mattes, J. (1980). A controlled trial of behavior modification and methylphenidate in hyperactive children. In C. Whalen & B. Henker (Eds.), ***Hyperactive children: The social ecology of identification and treatment*** (pp. 221-243). New York: Academic Press.

Gittelman and colleagues compared the relative efficacy of methylphenidate alone to behavior therapy combined with methylphenidate or placebo for children with hyperactivity. Their subjects were 58 boys and 3 girls, ages 6 to 12 years, who had been referred to a psychiatric clinic where, based upon parent reports and teacher ratings, the researchers diagnosed them as hyperactive.

The researchers randomly assigned the subjects to three 8-week treatment groups: methylphenidate alone, behavior therapy with methylphenidate, and behavior therapy with placebo. They trained parents to deliver behavior therapy at home and instructed teachers on how to implement it in the classrooms. Behavioral techniques included token reinforcement, social reinforcement, time out, and contracting. With guidance from a therapist, each subject, along with the subject's parents and teacher, wrote a contract that specified behavioral goals and identified reinforcers. The therapist monitored progress and gave counseling and additional training in weekly sessions with each subject and his or her parents and teacher. Additionally, the therapist modeled and role-played social coping strategies and, for many of the subjects, made weekly (or more frequent) phone calls to parents and subjects to monitor progress and conduct additional counseling.

On measures of attention, behavior, and activity level, all three groups improved, but the two medication groups (behavior therapy with methylphenidate and methylphenidate alone) improved significantly more than did the behavior therapy with placebo group. Differences between the two methylphenidate treatments were insignificant for all measures except one: in-seat activity level, for which methylphenidate with behavior therapy was significantly more effective than methylphenidate alone. Though behavior therapy was significantly less effective than stimulant treatment, parents and teachers of children who received behavior therapy rated the children as much improved. The researchers conjectured that these reports were probably affected by expectations. They also noted a change in parental attitude toward behaviorally treated subjects such that parents became more positive and accepting toward their children. The researchers concluded that, for children with hyperactivity, stimulant treatment is more effective than behavior therapy, but they recommended that behavioral treatment be added when medication alone is insufficient.

Gittelman-Klein, R., Klein, D.F., Abikoff, H., Katz, S., Gloisten, A.C., & Kates, W. (1976). Relative efficacy of methylphenidate and behavior modification in hyperkinetic children: An interim report. *Journal of Abnormal Child Psychology, 4*, 361-379.

After screening children for hyperactivity, the researchers randomly assigned 32 boys and 2 girls between the ages of 6 and 12 to one of three treatments: behavior therapy with methylphenidate, methylphenidate alone, or behavior therapy with placebo. For the behavior therapy conditions, parents and teachers, who received training in behavior management techniques, utilized token reinforcement in the children's homes and regular classrooms.

Following treatment, children from all three groups displayed significantly reduced minor motor activity but no reduction in solicitation of teacher attention. Children who received behavior therapy with methylphenidate or methylphenidate alone showed significant improvements on inattention, sociability, and disruptive behavior. The group that received behavior therapy with placebo showed a trend, though not statistically significant, toward improvement on factors of inattention and sociability, but no significant reduction in disruptive behavior. Methylphenidate alone and behavior therapy with methylphenidate were significantly superior to behavior therapy with placebo on improving ratings of conduct disorder, inattention, hyperactivity, sociability, and disruptive behavior. There was no significant difference between methylphenidate alone and behavior therapy with methylphenidate. Additionally, teachers rated the combined treatment of behavior therapy with methylphenidate as more favorable than behavior therapy with placebo.

The researchers concluded that the combination of behavior therapy with methylphenidate was consistently the most effective treatment, followed by methylphenidate alone. Behavior therapy with placebo was the least effective. The authors stressed that, because of the characteristics of their subjects, the results are generalizable only to children with

severe hyperactivity. Moreover, they suggested that a behavioral approach may offer a valuable therapeutic treatment for children who cannot tolerate medication or whose parents resist medicating their children.

Gordon, M., Thomason, D., Cooper, S., & Ivers, C.L. (1991). Nonmedical treatment of ADHD/hyperactivity: The Attention Training System. *Journal of School Psychology, 29*, 151-159.

The authors examined a classroom management approach that uses a teacher-controlled electronic counter to implement a token reinforcement and response-cost system. According to the authors, the electronic module mounted on a student's desk is well-suited for use in regular and self-contained classrooms. The subjects of the study were 3 boys and 3 girls between the ages of 6 and 9 who were referred to a private-practice clinic where they were diagnosed with ADHD. The setting for the study was a once-a-week treatment program held in a large therapy room under the direction of a certified teacher.

The study followed a single-subject ABA design in which the number of the children's off-task behaviors were recorded during baseline and training phases. During training, the students earned points for each minute they attended to worksheets. They lost points when they left their seats, went off task, made noises, or touched the point-recording device. For five of the children, off-task behaviors decreased during the training phase but rose when the electronic counter was removed. The sixth child showed initial improvement but behaved inconsistently as the study progressed.

The authors concluded that a strategic combination of meaningful, predictable, and immediate positive rewards and negative consequences may be the most effective method for decreasing classroom inattention. They added, however, that because gains in attentiveness dissipated after the short training phase, in practice, the electronic apparatus should be implemented for a longer period, or even on an ongoing basis, to allow gains in attentiveness to be internalized.

Guevremont, D.C., Tishelman, A.C., & Hull, D.B. (1985). Teaching generalized self-control to attention-deficient boys with mothers as adjunct therapists. *Child and Family Behavior Therapy, 7*, 23-37.

Subjects for this study were 2 boys, ages 9 and 10, who were referred to a community mental health clinic and reported to be impulsive and lacking self-control. Upon referral, they received diagnoses of ADDH. Using a single-subject, multiple baseline design, the researchers examined a self-instructional training program targeting specific problem behaviors and completion of daily classroom worksheets. The three treatment phases were baseline, conceptual self-instructional training, and concrete self-instructional training. For one of the boys, the researchers also conducted a follow-up baseline phase.

The boys and their mothers attended seven or eight weekly sessions, which were 50 minutes in length. Self-instructional training used modeling, positive reinforcement, and response-cost to develop the subjects' conceptual and concrete (task-specific) verbalizations regarding completion of classroom work. During conceptual training, self-instructions were general statements independent of the specific task requirements (e.g., "What do I have to do first?" and "Concentrate on one problem at a time."). During concrete training, verbalizations were specific to the worksheet requirements (e.g., "I have to multiply 7 and 4 and carry the 2.") on mathematics, spelling, and reading worksheets obtained from the boys' teachers. The researchers also taught the boys' mothers to conduct home self-instructional training. Concrete and conceptual training at home occurred concurrent with clinical training.

Overall, with self-instructional training, both subjects substantially improved percent of daily classroom work completed. During conceptual training they demonstrated considerable, though variable, improvement. With the implementation of concrete training their performance stabilized and rate of work increased. Pre- and post-treatment parent and teacher ratings indicated that the boys were more self-controlled and less hyperactive after treatment. Their school grades also improved after treatment. The authors noted that self-instructional training was effective and generalized to improve classroom performance even though training occurred in a clinical setting. They concluded that combining the two approaches to self-instructional training is an effective way to teach children general problem-solving skills as well as task-specific strategies.

Hall, C.W., & Kataria, S. (1992). Effects of two treatment techniques on delay and vigilance tasks with attention deficit hyperactive disorder (ADHD) children. *The Journal of Psychology, 126,* 17-25.

Hall and Kataria examined the relative effectiveness of behavior modification and cognitive training implemented with and without medication. Their subjects were 21 children, ages 6 to 12, who were clinically diagnosed with ADHD. They randomly assigned the children to three treatment groups: behavior modification, cognitive training, or control. In a children's learning clinic, the children in each group performed delay and vigilance tasks both on and off methylphenidate. The behavior modification group received direct reinforcement during the tasks. For the delay task there was also a response-cost contingency. The cognitive-training group received training in verbal self-instruction on how to approach the two tasks. The control group performed the tasks with no intervention other than the on- and off-medication conditions.

Neither behavioral treatment, cognitive training, nor medication alone significantly improved sustained attention, though there was a trend toward better performance when the behavioral and cognitive interventions were combined with medication. The combination of cognitive intervention and medication was the only intervention that significantly improved subjects' abilities to delay impulsive responding. Noting that an intervention is more likely to be implemented appropriately if it is viewed as acceptable,

Hall and Kataria assessed parent and child acceptance of the interventions. Parents rated the cognitive treatment significantly higher than the control and the combination of medication and cognitive intervention significantly higher than for medication alone. There were no significant differences in parents' ratings of cognitive versus behavioral treatment or behavioral intervention versus control, or in the childrens' ratings of the three interventions.

Hall and Kataria concluded that the results partially support the combination of medication and cognitive intervention. Although the combination improved performance on the delay task, it did not do the same for the vigilance task. As support for their conclusion, they noted that parents rated the combination approach as more acceptable than medication alone. Regarding behavioral intervention, the researchers suggested that children's excitement over possible reinforcement may have caused their performance to deteriorate on the vigilance task. They contended that tangible reinforcers combined with response-cost can be beneficial, but tangible reinforcers alone may lead to increased careless errors. They recommended that behavior modification programs be assessed carefully for children with ADHD, with consideration given to individual task demands and child needs.

Hinshaw, S.P., Henker, B., & Whalen, C.K. (1984a). Cognitive-behavioral and pharmacologic interventions for hyperactive boys: Comparative and combined effects. ***Journal of Consulting and Clinical Psychology, 52,*** **739-749.**

The researchers hypothesized that reinforced self-evaluation would increase positive social behavior and reduce negative social behavior more than reinforcement alone. To clarify medication effects and evaluate their effectiveness with this cognitive-behavioral intervention, the researchers also compared methylphenidate and placebo. Their subjects were 24 hyperactive boys, ages 8 through 13, and 9 nonhyperactive comparison boys. The hyperactive boys were medically diagnosed with hyperactivity, hyperkinesis, or ADDH, and were further screened by the researchers on measures of hyperactivity and attention deficit disorder. Prior to instruction in self-evaluation skills for this study, the hyperactive participants had received cognitive-behavioral training in self-instruction and anger control.

The researchers taught the boys cognitive-behavioral self-monitoring and self-evaluation techniques in a summer school program for hyperactive boys and conducted the comparison study in a naturalistic playground setting where subjects participated in semistructured cooperative and competitive games. The researchers assessed the effects of four intervention combinations on the boys' social behavior: reinforced self-evaluation with placebo, reinforced self-evaluation with methylphenidate, reinforcement-alone with placebo, and reinforcement-alone with methylphenidate. In the reinforced self-evaluation conditions the boys earned points for both cooperation and accurate self-evaluations. In the reinforcement-alone conditions, the boys received points for cooperation but were not required to self-evaluate. Boys who earned enough points received swimming privileges.

The researchers found that overall methylphenidate was more effective than placebo, and reinforced self-evaluation more effective than reinforcement-alone, in improving social behavior of hyperactive subjects. Looking at treatment combinations, they found no significant differences between the methylphenidate and placebo groups under reinforced self-evaluation, while methylphenidate was more effective than placebo in the reinforcement-alone condition. Furthermore, the two reinforcement conditions were not significantly different under methylphenidate, but under the placebo condition, reinforced self-evaluation was superior to reinforcement-alone. When they ranked the interventions, the researchers concluded that cognitive-behavioral self-evaluation with medication was superior, and reinforcement-alone with placebo was least effective. They speculated that reinforcement-alone may have proven more effective had they determined reinforcers on an individual basis.

Hinshaw, S.P., Henker, B., & Whalen, C.K. (1984b). Self-control in hyperactive boys in anger-inducing situations: Effects of cognitive-behavioral training and of methylphenidate. *Journal of Abnormal Child Psychology, 12*, 55-77.

Hinshaw, Henker, and Whalen presented two studies aimed at assessing the effectiveness of methylphenidate and cognitive-behavioral training (based on a stress inoculation paradigm) in reducing aggression and increasing anger control in hyperactive children. The subjects for these two studies were boys, ages 8 through 13, who had been previously diagnosed by a physician as hyperactive or hyperkinetic. Prior to the studies, all of the subjects were taking methylphenidate as part of their treatment for hyperactivity, and each had a history of favorable response to stimulant medication.

In the first experiment, the researchers placed 21 boys into groups of three, determined by order of admittance into an outpatient psychology clinic. Each triad underwent group training in self-control for 3 weeks. Two graduate students in clinical psychology trained each triad in both cognitive and interpersonal problem-solving skills and in self-control techniques. Additionally, the researchers assigned each subject to either a methylphenidate or a placebo drug condition. Using a repeated measures design, the researchers twice assessed the subjects on measures of self-control, intensity of reaction, activity level, and aggression during tests in which peers willfully provoked them. The first test followed four training sessions and the second test followed additional training and individualized coaching sessions. Results indicated that subjects demonstrated a greater amount of self-control after the trainers coached them in strategies and helped them rehearse those strategies. Additionally, methylphenidate had a statistically significant effect on the tendency of subjects to leave the provoking situation and on the strength, or vigor, of the subjects' responses to provocation.

In the second study, the researchers investigated the effects of more extensive training in the cognitive problem-solving techniques. Twenty-four boys who had received diagnoses of hyperactivity, hyperkinesis, or ADDH participated in a university-based summer program for 3 weeks. Using a complex design that makes definitive interpretation of the

results difficult, the researchers divided the subjects into groups of four and provided training to all subjects in problem-solving, attributions, and cognitive self-instruction, and additional specialized cognitive training to some subjects in anger control and interpersonal problem-solving strategies. The researchers also randomly assigned two boys from each group of four to methylphenidate treatment and two boys to placebo treatment. The subjects who participated in the specialized cognitive training exerted significantly more self-control and exhibited twice as many coping and self-control strategies as the subjects who did not participate in the training. Results also showed no significant medication effect except in the area of forcefulness of reaction.

Hinshaw, Henker, and Whalen concluded that their research supports the notion that training in anger recognition and self-control strategies can be an effective technique for children with hyperactivity.

Hinshaw, S.P., & Melnick, S. (1992). Self-management therapies and attention-deficit hyperactivity disorder: Reinforced self-evaluation and anger control interventions. *Behavior Modification*, *16*, 253-273.

Hinshaw and Melnick presented two case studies examining multimodality treatment of children with ADHD. The authors used two training procedures that they consider to be effective adjuncts to behavioral and pharmacologic interventions for children with ADHD. The first of these, reinforced self-evaluation, was a series of activities designed to enhance children's self-monitoring and self-evaluation skills. This is accomplished mainly through an exercise the authors developed called the "Match Game." In this exercise, the therapist outlines and models the behavior that the child is to emulate. The therapist then observes the child and rates the child's performance of the targeted behavior, while the child also rates his or her own behavior. The child and the therapist discuss their respective ratings, and the therapist encourages the child to recall the exact behaviors that led to the given rating. The therapist reinforces the child for matching the therapist's evaluation. The second training procedure that Hinshaw and Melnick used is group instruction in anger control and anger management, which teaches the child to exercise restraint under peer and teacher provocation--either by ignoring, problem-solving, or some other non-aggressive procedure.

In the first case study, the authors described a 9-year-old boy whose problems included extreme hyperactivity, aggression, and oppositionality. Multimodality treatment for this child included methylphenidate, operant behavioral procedures, and anger management training. While this child mastered the anger control procedures during training, the effects did not transfer to situations unrelated to the training itself. In the second case study, the authors described a 10-year-old boy whose treatment for ADHD included methylphenidate, operant behavioral conditioning, reinforced self-evaluation, anger management training, and the Match Game. This boy proved to be a good responder to methylphenidate therapy and was also particularly adept at self-monitoring and self-evaluation. In addition, he performed extremely well during the anger control training.

Hinshaw and Melnick concluded that cognitive procedures can be very effective if they are used as an adjunct to behavioral strategies. They also suggested that future research concentrate not on which interventions are the most effective for children with ADHD, but rather, on discovering "the optimal combinations of strategies, delivered over lengthy periods."

Horn, W.F., Chatoor, I., & Conners, C.K. (1983). Additive effects of dexedrine and self-control training: A multiple assessment. *Behavior Modification, 7,* 383-402.

Horn, Chatoor, and Conners studied the effects of dexedrine and self-control training alone and in combination. Their subject was a 9-year-old boy who had been referred to an inpatient psychiatric unit, in a children's medical hospital, where he had received a primary diagnosis of ADD with hyperactivity and a secondary diagnosis of undersocialized conduct disorder.

Over a 10-week period, using a changing conditions design, the researchers systematically applied and withdrew dexedrine during the absence or presence of self-control procedures (self-instructional training, self-monitoring, and self-reinforcement). Outcome measures included observations of unit classroom behavior, teacher ratings of hyperactivity, tests of cognitive performance, and measures of academic achievement. By the end of 7 weeks, treatment had not affected cognitive and academic performance; therefore, the researchers instituted token reinforcement for correct responses on cognitive and academic assignments.

Results showed that dexedrine plus self-control training was more effective in increasing on-task behavior and decreasing teacher reports of hyperactivity and distractibility than either dexedrine alone or self-control training plus placebo. Dexedrine, but not self-control training, effectively increased sustained attention and decreased impulsive responding. Only token reinforcement for correct responses improved cognitive and academic performance. For that reason, the researchers recommended that direct reinforcement for accuracy be included with self-control training. The authors concluded that their results indicate that stimulant medication combined with self-control training is an effective treatment for children with attention deficits.

Horn, W.F., Ialongo, N., Greenberg, G., Packard, T., & Smith-Winberry, C. (1990). Additive effects of behavioral parent training and self-control therapy with attention deficit hyperactivity disordered children. *Journal of Clinical Child Psychology, 19,* 98-110.

Horn and his colleagues studied 42 children, clinically diagnosed as ADHD, who were between the ages of 7 and 11, and 18 non-ADHD comparison children. Their purpose was to determine the effectiveness of a combined program of behavioral parent training and child self-control instruction versus either treatment alone. The researchers randomly

assigned the 42 ADHD subjects to one of three treatment conditions: parent training, self-control instruction, or parent training plus self-control instruction.

The subjects and their parents participated in 12 weekly 90-minute training sessions. The parents in the parent-training condition learned about principles of social learning and behavior modification and how to apply these principles to their own parenting. The children who participated in the self-control condition learned and rehearsed problem-solving and relaxation techniques. Parents and children in the parent-training-plus-self-control condition participated in both treatments. In addition, the researchers contacted the subjects' teachers and informed them about the therapy program and encouraged them to participate, either by sending home daily report cards to parents in the parent-training program, or by prompting the subjects in the self-control program to use their problem-solving skills at school.

Pretest, posttest, and follow-up analyses of parent and teacher reports of child behavior did not indicate overall additive effects for the combined treatments. The combined treatments did not produce effects that endured longer or generalized better to other situations than either treatment alone, though, as reported by parents, the combined treatment did produce a significantly greater proportion of improvements in some behaviors. None of the groups made significant gains on measures of academic achievement or cognitive style. While none of the treatments proved to be truly superior to any other, teachers of all subjects did report gains in the subjects' behavior at posttest, though these gains were not maintained at follow-up. The authors concluded by stating that the results "provide some weak support" that a combination of treatments is more effective in alleviating the symptoms of ADHD. They suggested that future research concentrate on intensive, time-unlimited, and multimodal intervention.

Horn, W.F., Ialongo, N., Popovich, S., & Peradotto, D. (1987). Behavioral parent training and cognitive-behavioral self-control therapy with ADD-H children: Comparative and combined effects. *Journal of Clinical Child Psychology, 16*, 57-68.

Concerned with the lack of generalization and maintenance of treatment gains obtained with behavioral parent training and cognitive-behavioral self-control therapy, the authors tested a combination of these two strategies. They hypothesized that a combined approach would alter contingencies in the children's homes that maintain maladaptive behavior, while helping children develop more adaptive self-control skills. The researchers studied 24 elementary school children with ADDH, and their parents, by comparing behavioral parent training alone, child self-control instruction alone, and a combination of the two treatments. They randomly assigned 8 families to each of the treatment conditions, and each intervention group met weekly for eight 90-minute sessions, led by two graduate students at an outpatient psychology clinic. The behavioral parent training focused on teaching parents to apply principles of social learning theory to the management of their children's behavior and included the development of specific skills such as observing and charting behavior, positively reinforcing appropriate behavior, using extinction and

punishment procedures, and contingency contracting. The self-control instruction provided children with self-control strategies centered around a "problem-solving plan" that incorporated a series of self-instructional steps. During the self-control instruction sessions, the trainers used a token reinforcement system and a time-out procedure for managing the children's behavior.

Pretest, posttest, and one-month follow-up measures addressed locus of control, hyperactivity, child perception of behavioral self-control, self-esteem, attentional skills, impulse control, classroom behavior, parental attitudes toward discipline and child rearing, and a number of other variables. All three treatment groups showed significant behavioral improvements in the home at posttest and follow-up, but differential improvements across treatment occurred in only 1 of 32 possible comparisons (greater decrease in hyperactivity scores at follow-up for children in the self-instruction alone group). According to the authors, the results do not support the hypothesis that combining behavioral parent training and cognitive-behavioral self-control therapy produces greater treatment effects than either treatment alone. Additionally, the combined treatment condition failed to produce generalization of treatment effects from the home to the classroom.

Hoza, B., Pelham, W.E., Sams, S.E., & Carlson, C. (1992). An examination of the "dosage" effects of both behavior therapy and methylphenidate on the classroom performance of two ADHD children. *Behavior Modification, 16,* 164-192.

To explore individual treatment responses among children with ADHD, the researchers administered varied doses of methylphenidate and different potencies of behavior therapy in a summer treatment program classroom setting. They used a single-subject design to study 2 boys, ages 10 and 11 (Cases 1 and 2), whom they diagnosed as having ADHD. The boys participated in classroom and recreational activities in a group of 12 children.

The researchers manipulated, independently and jointly, pharmacological and behavioral treatments during the 8-week program. The classroom behavioral treatment varied in potency with "standard behavior modification" consisting of reward and response-cost procedures using a point system, time-out from positive reinforcement for extreme negative behaviors, a special privilege system, and a home-based daily report card. (In weekly parent-training sessions, the parents learned procedures for reinforcing performance on the report card.) In the more potent behavioral condition, children earned pool privileges rather than points, and criteria were more stringent. Methylphenidate treatment was individualized. Treatment in Case 1 varied such that the boy received placebo and two doses of methylphenidate at different times during the course of the program. The second boy received two different doses and no placebo.

Overall, both boys responded well to behavior therapy on the outcome variables of disruptive behavior, seatwork completed, and seatwork correct. For Case 1, behavior therapy and a low dose of methylphenidate had comparable effects, although the more potent behavioral treatment was necessary to consistently improve his disruptive behavior.

Increased medication dosages did not lead to improvements on any of the three variables. Though the boy did better on the high dose than on placebo when behavioral contingencies were not in place, his performance with a high dose of medication alone was poorer than with the low dose combined with behavior therapy. For Case 2, behavioral treatment or medication alone where both insufficient to change academic and behavioral performance in the classroom, but the two treatments together were highly effective. To achieve maximal change, however, required the potent behavioral contingency combined with the high dosage of methylphenidate.

According to the researchers, the findings in Case 1 illustrate the importance of assessing medication dose response within the context of differing "doses" of behavior therapy. Otherwise, in this case, it would not have been discovered that the boy could perform academically as well when treated with behavior modification as with medication, or that a behavioral intervention with potent consequences could be as effective as medication in controlling his disruptive behavior. The results in Case 2, they noted, demonstrate that difficult-to-manage children who respond insufficiently to either treatment alone often can be effectively managed with combined treatments involving potent "doses" of both interventions.

Kendall, P.C., & Braswell, L. (1982). Cognitive-behavioral self-control therapy for children: A components analysis. ***Journal of Consulting and Clinical Psychology, 50,*** 672-689.

With an elementary school as the intervention setting, Kendall and Braswell compared the effects of cognitive-behavioral treatment and behavioral intervention on classroom behavior, self-concept, self-control, and academic performance. Subjects were 23 male and 4 female students, ages 8 to 12, who were referred by their third- to sixth-grade teachers for exhibiting poor self-control in the classroom. The students attended 12 individual sessions with a therapist with the session content determined by random assignment to one of three conditions: cognitive-behavioral treatment, behavioral treatment, and control. The cognitive-behavioral treatment consisted of training in verbal self-instruction that focused on problem-solving skills, social reward for correct performance, response-cost for errors, and positive reinforcement for target behaviors. The behavioral treatment was identical to the cognitive-behavioral treatment, but without self-instructional training and cognitive modeling of problem-solving skills. The control group received all training materials, but no self-instruction training, modeling, or behavioral contingencies.

Following treatment, teacher ratings of self-control for the cognitive-behavioral group indicated significant improvement. Teacher ratings of hyperactivity showed significant improvements for both the cognitive-behavioral and behavioral groups. Parent ratings indicated no significant improvements in self-control or in hyperactivity for either group. Children's reported self-concept improved in the cognitive-behavioral condition, and children in both treatment conditions improved on the performance measures and exhibited

fewer off-task verbal and physical behaviors. The 10-week follow-up assessment showed the cognitive-behavioral treatment as superior, but after one year, no significant differences could be found across treatment conditions. The researchers concluded that cognitive-behavioral treatment improves student self-control. Noting its limitations for generalizing to the home or for maintaining long-term effects, they recommended modifying the intervention by extending its duration or including family members in treatment.

Loney, J., Weissenburger, F.E., Woolson, R.F., & Lichty, E.C. (1979). Comparing psychological and pharmacological treatments for hyperkinetic boys and their classmates. *Journal of Abnormal Child Psychology*, 7, 133-143.

Loney, Weissenberger, Woolson, and Lichty studied 12 boys, ages 6 to 12, who were diagnosed as hyperkinetic. The researchers' purpose was to investigate the short-term effects of pharmacological treatment versus behaviorally oriented teacher consultation on the on-task classroom behavior of these boys. The researchers did not randomly assign the subjects to the treatment conditions, but grouped them according to the treatment preferences of their outpatient psychiatrist.

To establish preintervention levels of on-task behavior, trained observers rated each subject in his classroom. The researchers consulted with the teachers of boys in the consultation group to establish a behavioral treatment program individualized to both the subjects' and the teachers' needs. As a result of this individualized consultation approach, the subjects received different behavioral interventions. With all teachers, however, the consultation encouraged them to increase the ratio of approval to disapproval, decrease the intensity of disapprovals, and ignore off-task behavior when possible. The subjects in the pharmacological treatment group received individually titrated dosages of methylphenidate. After 8 to 12 weeks of treatment, the trained observers again recorded the classroom on-task behavior of the subjects.

Results indicated that both treatment groups showed significant gains in on-task behavior although the behavior of the subjects treated with methylphenidate came closer to "average" behavior than the behavior of the behaviorally treated subjects. Interestingly, the teachers of the behaviorally treated subjects noticed that the on-task behavior of the subjects' overactive classmates also seemed to improve. This was not true for the overactive classmates of the pharmacologically treated subjects. Because of limitations in their study's design, the researchers did not draw definitive conclusions about the treatment effects. They did note, however, that the effects of drug and behavioral treatments on the children's on-task behavior were similar. They also contended that consulting with classroom teachers to deliver contingent reinforcement can be a feasible and effective intervention for students diagnosed as hyperkinetic.

Lubar, J.O., & Lubar, J.F. (1984). Electroencephalographic biofeedback of SMR and beta for treatment of attention deficit disorders in a clinical setting. *Biofeedback and Self-Regulation, 9,* 1-23.

Lubar and Lubar studied the effects of brainwave biofeedback and a special academic technique combined with brainwave biofeedback. They conducted 6 case studies with males, ages 10 to 19, who had been referred to a private biofeedback clinic. Most of the subjects had disabilities or behavior problems, including attention deficits, severe learning disabilities, and extreme aggressiveness.

For each subject, the researchers conducted two 40-minute biofeedback sessions per week for 10 to 27 months. Also, they combined biofeedback with academic training in which subjects practiced focusing attention during various academic exercises. All subjects decreased gross movement and exhibited expected brainwave and muscle activity effects. They all improved on school grades and achievement test scores, and their parents and teachers reported improved behavior.

Lubar and Lubar, noting that their data were preliminary and the sample small, nonetheless, concluded that their study was significant because it showed positive effects as a result of a long period of carefully administered training and integration of biofeedback with academic remediation. Because the researchers did not control for the effects of academic remediation without biofeedback, they suggested that the individual effects of biofeedback and academic remediation should be examined in future, controlled studies.

Moore, S.F., & Cole, S.O. (1978). Cognitive self-mediation training with hyperkinetic children. *Bulletin of the Psychonomic Society, 12,* 18-20.

Moore and Cole's purpose in this study was to determine the effectiveness of a training procedure aimed at teaching hyperactive children to verbalize problem-solving strategies for cognitive tasks. The subjects were 14 children, aged 8 to 12, who were in residence at a special education facility. School personnel at this facility had tested each child upon admission and had diagnosed the subjects for this study as hyperkinetic.

Six undergraduates participated in extensive training with the lead author in order to establish their command of the "cognitive self-mediation" technique. The researchers then assigned each undergraduate trainer to one experimental subject and one placebo subject. Trainers taught the cognitive self-mediation technique to experimental subjects but only worked on similar worksheet-type activities with the placebo subjects. A third group served as control subjects and received no treatment at all.

While pretest-posttest analyses indicated that the children trained in cognitive self-mediation improved on a measure of cognitive impulsivity, on scanning ability, and also on several WISC-R subtests, the authors cautioned that such improvements might be

limited in their generalization to other areas. In fact, the self-mediation training did not result in any significant changes in classroom behaviors as measured by a teacher-completed behavior rating scale. The researchers conjectured that the cognitive, as opposed to socially oriented, content of the study's tasks did not transfer to the social environment of the classroom.

O'Leary, K.D., Pelham, W.E., Rosenbaum, A., & Price, G.H. (1976). Behavioral treatment of hyperkinetic children: An experimental evaluation of its usefulness. *Clinical Pediatrics, 15*, 510-515.

O'Leary and his colleagues evaluated the effectiveness of a combined school-home behavioral treatment for children referred for hyperactivity. The subjects were 17 elementary school children, ages 8 to 11 years, whom teachers rated as extremely hyperactive on a teacher rating scale. In addition, observers rated the experimental subjects as having significant difficulty in the areas of movement and attention to task.

The researchers randomly assigned experimental subjects to either a behavioral treatment group or a no-treatment group. The behavioral treatment program consisted of the setting of daily classroom goals, positive social reinforcement from the child's teacher for the child's attempts to achieve the goals, daily evaluation by the teacher of the child's relevant behavior, and finally, parent reward of the child for progress toward daily goals. Teachers submitted report cards to parents daily.

Analyses of scores on two teacher rating scales indicated that while both the experimental and the control groups showed some improvement in behaviors related to hyperactivity, only the experimental group evidenced significant change. The authors concluded that behavior therapy should be considered to be an effective alternative or adjunct to pharmacological treatment of hyperactivity in children. They stressed that, for the positive effects of drug therapy to last in the long-term, medication should be combined with educational and psychological management. They also contended that behavior therapy is uniquely suited for use as an adjunctive therapy in the home setting, particularly because the effects of stimulant medication may dissipate in the evenings when children are home.

Paniagua, F.A. (1992). Verbal-nonverbal correspondence training with ADHD children. *Behavior Modification, 16*, 226-252.

Correspondence training, a method in which language is used to mediate between verbal and nonverbal behavior, has been used to decrease inappropriate behaviors in children and adolescents with ADHD. The present study describes the application of verbal-nonverbal correspondence-training procedures for 5 boys, ages 6 to 10 years, during inpatient psychiatric treatment. The children were diagnosed ADHD on the basis of a teacher rating scale and a history of behavioral problems. The children's IQs were 70 or above, they

were not currently taking medication, and they showed no other sensory or neurological deficits.

The experiment compared three separate correspondence training conditions. In the first condition, three children received reinforcement for the correspondence between doing a desired behavior and later accurately reporting what they had done (the "do-report" technique). For the second condition, one child received reinforcment for the correspondence between saying what he would do and then following up with the behavior (the "report-do" technique). The child in the third condition was first questioned about intentions, shown the reward he could earn, and then reinforced upon completion of the promised behavior (the "reinforcement set-up report-do" technique). The children had to meet increasing percentages of reduced inappropriate behaviors, and each condition had a generalization and follow-up phase during which there were no criterion or reinforcement contingencies.

Measures included classroom and therapy room observations of inattention, overactivity, and conduct problems. The results in all cases were the consistent reduction of inappropriate behaviors from baseline measures after correspondence training techniques. Although the researchers concluded that correspondence training offers a viable alternative for managing behavior of children with ADHD, they cautioned that it may not be practical because it is time consuming, requires a knowledgeable clinician, and requires the accurate measurement of corresponding behaviors.

Paniagua, F.A., & Black, S.A. (1990). Management and prevention of hyperactivity and conduct disorders in 8-10 year old boys through correspondence training procedures. *Child and Family Behavior Therapy, 12,* 23-56.

Paniagua and Black conducted this study to corroborate previous findings regarding the successful use of correspondence training for managing ADD. Within a university-based treatment facility, they implemented a correspondence training program across three settings: a treatment room, a classroom, and a simulated classroom. Their subjects were 8 boys with ADHD, ages 6 to 10 years, who also had conduct disorders. The training targeted the subjects' inattention, overactivity, and behavior typical of conduct disorders (aggressiveness, destructiveness, and inappropriate noise).

With four subjects, Paniagua and Black implemented the "reinforcement-set-up-on-promises" procedure in which a therapist displayed a reinforcer contingent upon each subject's promise to inhibit target behaviors. The therapist later delivered the reinforcer after each subject fulfilled the promise. For three boys, the researchers used the "reinforcement-of-corresponding-reports" procedure whereby a therapist reinforced subjects' true reports of target behaviors inhibited. For one subject, they used the "reinforcement-of-fulfillment-of-promises" technique in which a therapist delivered a reinforcer after the subject fulfilled a promise to inhibit target behaviors.

All procedures consistently lowered the levels of inattention, overactivity, and conduct disorders. With some subjects, the training also improved academic performance. From the results, Paniagua and Black concluded that correspondence training is a "feasible and practical" intervention for the prevention of problem behaviors of hyperactive children with conduct disorders. Because the effectiveness of specific reinforcers varied with subjects (e.g., some preferred activities, others preferred tangible rewards), the researchers also stressed the importance of taking care in the initial selection and later revision of reinforcers for individual children.

Paniagua, F.A., Morrison, P.B., & Black, S.A. (1990). Management of a hyperactive-conduct disordered child through correspondence training: A preliminary study. *Journal of Behavior Therapy and Experimental Psychiatry, 21,* 63-68.

The authors described "correspondence training" as a nontraditional approach for managing hyperactive children that trains a relationship between verbal and nonverbal behavior. This relationship can be between what a person says and then does ("promise-do" correspondence) or between what a person does and later reports having done ("do-report" correspondence). In the study reported in this article, Paniagua and his colleagues provided promise-do correspondence training to a 7-year-old boy with diagnoses of ADHD and conduct disorder. They evoked promises to inhibit problem behaviors (inattention, overactivity, aggressiveness, destructiveness, and noise) and rewarded the subject with tangible reinforcers for (a) the promise, (b) fulfillment of the promise, and (c) consistent positive performance across observation intervals. During the observation periods, the subject was engaged in academic work.

Employing a single-subject, multiple baseline (across settings) design, the researchers found that correspondence training markedly decreased inattention, overactivity, and noise relative to baseline. The training generalized to the third setting before implementation of treatment in that setting, suggesting the possibility of a powerful effect. Aggressiveness and destructiveness were not major problems during baseline and, therefore, showed no decrease as a result of training. The researchers also reported that the results "suggest" improvements in academic performance as a result of the correspondence training. They described these results as indirect because they did not train for academic performance.

The authors concluded that correspondence training could be an alternative in the classroom management of children with ADHD and conduct disorders. They also pointed to the potential advantages of correspondence training compared to traditional interventions. Correspondence training emphasizes the management of maladaptive behavior before it occurs and offers the opportunity to prevent as well as change behavior.

Paniagua, F.A., Pumariega, A.J., & Black, S.A. (1988). Clinical effects of correspondence training in the management of hyperactive children. *Behavioral Residential Treatment, 3,* 19-40.

Paniagua, Pumariega, and Black studied the effectiveness of correspondence training in the management of ADDH. Their subjects were 3 boys, ages 6 to 9 years, who were admitted to a university-based treatment facility and diagnosed with ADDH.

Across two settings (a treatment room and a classroom) within the treatment facility, Subject 1 received reinforcement for correctly reporting his inhibition of hyperactivity ("reinforcement-of-corresponding-reports" procedure). Subject 2 received reinforcement after he promised to inhibit hyperactivity and subsequently fulfilled the promise ("reinforcement-of-fulfillment-of-promises" procedure). For Subject 3, the researchers used two procedures. One was the reinforcement-corresponding-reports procedure used with Subject 1 and the other was a "reinforcement-set-up-on-promises" procedure in which a therapist displayed reinforcement when the boy promised to inhibit hyperactivity and delivered it after fulfillment of the promise. The mother of Subject 3 also received behavioral training and participated in the boy's correspondence training during the final phase of the study.

Overall, with each correspondence training procedure, subjects decreased problem behaviors and increased levels of correspondence between verbal and nonverbal behavior. Subject 3, however, showed greater improvement when reinforcement was displayed contingent upon promises than when reinforcement was delivered for corresponding reports. Subjects 2 and 3 maintained improvements at follow-up, but Subject 1 did not. Paniagua, Pumariega, and Black inferred that the maintenance of improvements at follow-up demonstrated that correspondence training facilitated the development of self-control. They concluded that correspondence training is a promising intervention for children with ADDH.

Parry, P.A., & Douglas, V.I. (1983). Effects of reinforcement on concept identification in hyperactive children. *Journal of Abnormal Child Psychology, 11,* 327-340.

Parry and Douglas examined the effects of various schedules of reinforcement on the concept identification abilities of 30 hyperactive and 30 nonhyperactive elementary school children. The researchers presented each subject with two slides simultaneously, one of which depicted the target concept (e.g., "flower"). Through trial and error the subject obtained information about the concept, deduced the concept, and learned to choose the correct slide. The researchers continued the presentation of slide pairs for up to 300 trials or until the subject identified ten "flowers" correctly. Parry and Douglas's purpose in this research was to determine how different schedules of reinforcement would affect the subjects' abilities to identify the targeted concept.

The researchers randomly assigned the hyperactive and nonhyperactive subjects to one of three reward conditions. In the continuous-reward condition, subjects received a marble, redeemable for 25 cents, every time they correctly identified the targeted concept. They did not receive a marble for an incorrect answer. In the standard-partial-reward condition, the subjects received a marble for every other correct response and no marbles for incorrect responses. In the modified-partial-reward group, children received either a black or a white marble for every correct response, but only one of the colors was redeemable for the 25 cents.

The hyperactive subjects performed as well as the nonhyperactive comparison subjects in the continuous-reward condition, but, unlike the nonhyperactive subjects, the hyperactive subjects' performance in the two partial-reward conditions was markedly worse than their performance in the continuous-reward condition. The hyperactive subjects performed poorly during both partial-reward conditions even though the modified-partial-reward condition provided as much performance feedback as the continuous-reward condition. The authors concluded that the reduced performance of the hyperactive children under partial reward, therefore, was more likely attributable to a lack of motivation associated with frustration intolerance, as opposed to an information feedback deficit.

Pelham, W.E., Milich, R., & Walker, J.L. (1986). Effects of continuous and partial reinforcement and methylphenidate on learning in children with attention deficit disorder. *Journal of Abnormal Psychology, 95*, 319-325.

Pelham, Milich, and Walker studied 30 children to determine the interaction effects between psychostimulant medication and different schedules of reinforcement. The authors examined each child and interviewed parents to determine that all subjects had an attention deficit disorder. The subjects ranged in age from 5 to 11 years old. The researchers randomly assigned them to one of three treatment conditions: no reinforcement, continuous reinforcement, or partial reinforcement.

The experimental task consisted of 10 nonsense spelling words on each subject's individual spelling level, as determined by a pretest. The experimenters used a combination response-cost/token economy system for reinforcement of behavior and task accuracy. For all three treatment conditions, the subjects each began the testing session with 200 points, which they could lose for inappropriate behavior. The subjects in the continuous-reinforcement group earned 20 points for each correct response, and the subjects in the partial-reinforcement group occasionally earned 20 points for correctly spelled words. The subjects in the no-reinforcement group did not receive points for correct answers, but all groups received feedback as to whether or not their spellings were correct. All subjects in each condition received methylphenidate and a placebo--half of the subjects received methylphenidate first and the other half received a placebo first.

The researchers found that, across all three conditions, the subjects made 17% fewer errors when taking methylphenidate than when taking a placebo. Under the two reinforcement

conditions, subjects made 32% fewer errors compared to the no-reinforcement condition, but subject performance under the two reinforcement conditions did not differ. The results of this study, therefore, did not support the assertions of other researchers that children with ADD are particularly sensitive to partial-reinforcement schedules and that partial reinforcement will have a detrimental effect on their performance. The researchers also found that the combination of methylphenidate plus the merged reinforcement conditions yielded a 43% improvement in performance over the no-reinforcement/placebo condition. Pelham, Milich, and Walker concluded that future research should reevaluate the theory that children with ADD do not perform well under partial reinforcement because of their need for immediate reinforcement.

Pelham, W.E., Schnedler, R.W., Bologna, N.C., & Contreras, J.A. (1980). Behavioral and stimulant treatment of hyperactive children: A therapy study with methylphenidate probes in a within-subject design. *Journal of Applied Behavior Analysis, 13,* 221-236.

The authors implemented an intervention program comprising teacher and parent training, psychostimulant medication, and self-instructional training. Their subjects were 8 hyperactive children, 7 boys and 1 girl, ages 6 to 11, diagnosed with hyperkinetic reaction of childhood according to DSM-II criteria. Behavioral intervention focused on teacher and parent training over a 16-week period. The researchers trained each child's parents and regular teachers weekly, in individual sessions. In parent training, the parents designed contingency management programs to modify children's specific problem behaviors in the home. At the same time, the teachers devised programs to address each child's classroom problem behaviors. They implemented a daily report system in which children received behavior ratings on a take-home report, and later received rewards for good reports at home. In addition, children received several 20- to 30-minute tutoring sessions addressing self-instructional techniques. To determine the benefits of stimulant medication as an adjunct, the researchers administered three separate week-long medication probes. During medication probe weeks they gave children either a placebo or one of two doses of methylphenidate.

Behavioral intervention alone improved on-task behavior, but it was not maximally effective until combined with methylphenidate. Overall, methylphenidate improved the children's behavior both before and after behavioral intervention. On most measures, the high dose resulted in greater improvements than the low dose. Because gains were equivalent to those of a previous study utilizing identical treatment, with the exception of training in verbal self-instruction, the authors concluded that self-instruction was an ineffectual adjunct. Their interpretation of the results, consequently, focused on the behavioral and psychostimulant interventions.

Results indicated that the behavioral intervention influenced dosage effects. For example, according to observational measures, there was an interaction effect such that, prior to behavioral intervention, the high dose of medication improved on-task behavior more than the low dose. After behavioral intervention, however, the effects of both dosages were

equivalent. The authors surmised that behavior therapy and methylphenidate have additive and in some conditions, interactive effects. They concluded that, for hyperactive children in school settings, the combination of methylphenidate and behavior therapy may be more effective in the short-term than either treatment alone. Also, because parent ratings and clinic observations of parent-child interactions suggested that children had improved in the home setting, the researchers stressed that behavioral parent training is key to improving behavior in the home.

Pisterman, S., Firestone, P., McGrath, P., Goodman, J.T., Webster, I., Mallory, R., & Goffin, B. (1992a). The effects of parent training on parenting stress and sense of competence. *Canadian Journal of Behavioural Science, 24,* 41-58.

Pisterman and her colleagues studied 91 families of preschoolers, clinically-diagnosed with ADDH, to investigate the effects of behavioral parent training on parenting stress and sense of competence. Two cohorts of families that participated in studies evaluating group parent-training programs were the subjects of this study. The first parent-training program focused on the amelioration of child noncompliance, and the second addressed problems of noncompliance and short attention span. Because both programs had a positive impact on parent and child behavior, the researchers hypothesized that the therapeutic benefits would extend to parenting stress and sense of competence.

The researchers based their analysis on data collected pre and posttreatment and at 3-month follow-ups, combining data across the two studies. Measures included observation, child behavior ratings, and parent self-reports; and, for both studies, the researchers compared treatment groups to control groups of parents waiting for treatment. The results indicated that group parent training yielded benefits beyond changes in parent and child behavior. Parents who participated in the training groups reported significantly less parenting stress and increased sense of competence following treatment and at follow-up. Control group parents also reported some declines in stress over the same time period, but the declines were not nearly as great, and they reported no significant changes in sense of competence. (Stress level remained high, however, for both treated and control subjects.) Interestingly, the changes in parent stress and sense of competence were unrelated to improvements in actual parent and child behavior measured in the clinic setting but were related to parents' perceptions of improvement in child behavior.

The researchers concluded that this study supports the notion that parent-training programs that provide support, knowledge, and skills can benefit families and may be especially conducive to fostering a sense of parenting competence and combating depressive symptoms in parents. Furthermore, based on a transactional model of family functioning, they suggested that "alleviating parental stress and improving sense of competence not only provides immediate benefit but also has the potential for preempting dysfunctional recursive cycles that can lead to secondary problems and protracted family pathology."

Pisterman, S., Firestone, P., McGrath, P., Goodman, J.T., Webster, I., Mallory, R., & Goffin, B. (1992b). The role of parent training in treatment of preschoolers with ADDH. *American Journal of Orthopsychiatry, 62,* 397-408.

Pisterman and her colleagues assessed the effectiveness of group behavioral parent training for improving the compliance and time on task of preschoolers, ages 3 to 6 years. Training took place in a large Canadian pediatric hospital where 45 preschool subjects were diagnosed with ADDH. The researchers randomly assigned the children and their families to either the treatment or control group. They trained the parents in the treatment group in a 12-session treatment program. In the initial sessions, the researchers discussed the nature and treatment of ADDH. In subsequent sessions, they trained parents in behavioral techniques for increasing child compliance and shaping the on-task behavior of their children.

After parent training, measures of child compliance showed significant improvement, but measures of attention did not. Parent training had positive effects on parental behavior: parents improved compliance-management skills and overall style of interaction. They gave fewer directive statements and more positive feedback to children.

After examining the results, the researchers noted that the extremely high standard deviations associated with the attention measures typified the variable functioning and consequent behavioral unpredictability characteristic of children with ADDH. They surmised that behavioral parent training alone may be ineffective with behaviors that are biologically driven. They suggested that for intervention to be comprehensive, multiple treatment modalities that target specific problems and deficits may be required.

Pisterman, S., McGrath, P., Firestone, P., Goodman, J.T., Webster, I., & Mallory, R. (1989). Outcome of parent-mediated treatment of preschoolers with attention deficit disorder with hyperactivity. *Journal of Consulting and Clinical Psychology, 57,* 628-635.

The researchers evaluated the effectiveness of a group parent-training program designed to improve compliance of preschoolers with ADDH. Forty-six parents of preschool boys and girls, ages 3 to 6 and clinically diagnosed with ADDH, were randomly assigned to an immediate-treatment group (experimental group) or a delayed-treatment group (control group). The study's setting was a simulated living room, complete with age-appropriate toys, located in the psychology department of a Canadian pediatric hospital.

Each training cohort consisted of 10 families. The weekly training program extended for 12 weeks. Parents in the experimental group attended 10 group-training sessions and 2 individual sessions that included their children. The first 3 training sessions were informational in nature, addressing etiology, course, and treatment of ADDH, as well as practical issues such as developing support networks, childproofing the home, and

developing realistic expectations. The final 9, skill-oriented sessions addressed behavioral strategies.

On every measure of compliance, the experimental group showed significant improvement; the control showed no change. Treatment also improved parental style of interaction and management skills. The parents increased positive interactions and decreased directiveness. At a 3-month follow-up, the families had maintained their improvements. The authors concluded that behavioral parent training in a group setting is an effective early intervention program for preschoolers with ADDH because parents learn skills that can significantly improve the compliance of their children. The authors had hoped to find generalization effects across settings and behaviors, but they did not. They surmised that a training program directed at a wider application of compliance-training skills may be required to facilitate generalization.

Pollard, S., Ward, E.M., & Barkley, R.A. (1983). The effects of parent training and Ritalin on the parent-child interactions of hyperactive boys. *Child and Family Behavior Therapy, 5,* 51-69.

Pollard, Ward, and Barkley implemented parent training alone and in combination with methylphenidate to determine whether methylphenidate enhances treatment effects achieved initially through parent training, and whether parent training heightens effects produced by ongoing drug therapy. Using a single-subject design, they trained mothers of 3 hyperactive boys, ages 6 and 7, who had been referred to a child psychology clinic for evaluation of hyperactivity. Each boy subsequently received diagnoses of hyperactivity or ADDH. Prior to this study, each boy had shown a positive response to methylphenidate treatment.

The setting for training and observation was a child study room set up to simulate a home-like family room. Two of the mothers initially received instruction in child behavior management while their sons were off medication. After eight training sessions, the researchers re-instituted the boys' pre-treatment doses of methylphenidate and instructed the mothers to continue using their new parenting skills. The third boy received treatment in the reverse order. He took methylphenidate first, then remained on medication while his mother participated in parent training. Outcome measures included clinic observations and parent ratings of children's behavior.

Both treatments alone decreased the number of parental commands and improved parents' ratings of deviant child behavior in the home. Only parent training increased parents' use of praise and attention following child compliance. Each treatment produced variable and undramatic improvements in child compliance, but more consistent improvements in mean duration of compliance. According to the researchers, this increase in sustained compliance reflected improvements in attention span. Generally, parent changes were more reliable and of greater magnitude than changes in children's behavior, though the parent ratings of deviant child behavior showed the most substantial response to

intervention. Regardless of which treatment occurred first, all three boys showed considerable reductions in deviant behavior. Overall, the combination of treatments did not prove more effective than either treatment alone.

Pollard, Ward, and Barkley concluded that either parent training or methylphenidate alone can be successful interventions for hyperactive children, and that generally, the combination of the two treatments produces no further benefits. Noting, however, that with the addition of methylphenidate to parent training, one child did show some further improvement, they concluded that treatment effects can be idiosyncratic and may not always reflect average findings. They noted also that, although methylphenidate treatment has been found to elicit collateral gains in parental behavior as children's behavior improves, their finding that maternal positive attention did not increase without parent training indicates that some families may require direct instruction during drug therapy.

Rapport, M.D., Murphy, A., & Bailey, J.S. (1980). The effects of a response-cost treatment tactic on hyperactive children. *Journal of School Psychology, 18,* 98-111.

In this study, the researchers conducted two experiments to examine behavioral and medical interventions with hyperactive children. In Experiment 1, they studied the effects of positive reinforcement and response-cost on a young boy's hyperactive behavior and academic performance. The 7-year-old boy was in the second grade and was diagnosed by a physician as hyperkinetic. In Experiment 2, the researchers studied interventions utilizing Ritalin and response-cost. The subject was an 8-year-old girl in the third grade who had been medically diagnosed as hyperactive. For both experiments, the children's teachers implemented the interventions within their regular classrooms.

Experiment 1 followed a single-subject, changing-condition design with positive reinforcement and response-cost phases. The response-cost phase varied such that the boy sometimes earned free time for himself and at other times for the entire class. During the positive reinforcement phase he earned free time only for himself. Experiment 2 followed a single-subject, changing condition design with a reversal phase. The three intervention phases were Ritalin alone, response-cost plus Ritalin, and response-cost alone. The response-cost program was identical to the program implemented in Experiment 1 except the group contingencies were not used.

In Experiment 1, the response-cost system reduced the boy's off-task behavior and increased his completion of class work. Individual consequences were more effective than group consequences. In the positive reinforcement phase, which followed response-cost, the boy's on-task behavior and assignment completion decreased slightly but continued to be an improvement over baseline. In Experiment 2, the response-cost program alone and combined with medication decreased the girl's off-task behavior and improved her academic performance. Medication alone slightly increased her on-task behavior but did not increase completion of classroom assignments. Teachers rated the interventions in both experiments as practical and effective for classroom use. The authors concluded that

response-cost procedures can significantly improve on-task behavior and academic performance of hyperactive children and that medication does not significantly enhance the effectiveness of behavioral approaches.

Rapport, M.D., Murphy, H.A., & Bailey, J.S. (1982). Ritalin vs. response-cost in the control of hyperactive children: A within-subject comparison. *Journal of Applied Behavior Analysis, 15*, 205-216.

Rapport, Murphy, and Bailey compared the effectiveness of differing dosages of methylphenidate versus a response-cost/token economy system for improving phonics and math performance and on-task behavior of 2 boys with ADDH. The boys were students in consecutive years in the second-grade classroom where the study occurred. With the first subject, the teacher used a flipboard with numbers 0 to 20 as the major mechanism in her response-cost/token economy system. For the second subject, the teacher used an electronic display that she could control from across the room with a hand-held device.

The researchers used the same single-subject, changing-conditions design for both subjects, although some variation occurred in the number of days each treatment lasted. The baseline condition was followed by a 5 mg methylphenidate condition, a 10 mg methylphenidate condition, and a 15 mg methylphenidate condition. At this point, the subjects discontinued medication and the researchers again collected baseline data. Following the second baseline condition, the teacher initiated the response-cost/token economy condition. The response-cost/token economy condition was then discontinued and the 5 mg methylphenidate condition reinstituted. The final condition consisted of the reinstatement of the response-cost/token economy system.

Analyses of on-task behavior and academic performance across conditions indicated that both interventions were effective, but the greatest improvement in on-task behavior and academic performance for both subjects occurred during response-cost. Rapport and his colleagues noted that, though medication is easier to administer than is response-cost, pharmacotherapy is not necessarily the ideal intervention; some children continue to experience academic difficulty when treated with psychostimulants and others respond negatively to medication. They predicted, therefore, that behavioral interventions will continue to be needed for children with hyperactivity. They suggested that future research investigate the combination of methylphenidate and response-cost.

Rosén, L.A., O'Leary, S.G., & Conway, G. (1985). The withdrawal of stimulant medication for hyperactivity: Overcoming detrimental attributions. *Behavior Therapy, 16*, 538-544.

In this case study, Rosén, O'Leary, and Conway describe a 9-year-old hyperactive boy's withdrawal from methylphenidate. The boy attended the second grade at a special school for children with hyperactivity. His teacher referred him to the authors and reported that

when he did not receive stimulant medication, he suffered from a very short attention span, failure to complete assigned tasks, excessive daydreaming, and general overactivity.

During the first phase of the study, the authors reduced the boy's medication to a placebo-level dosage. With this dosage, the boy maintained a high level of productivity. When the boy's placebo therapy was unexpectedly terminated for four days, his school performance immediately declined and he began making attributions regarding the medication's control of his behavior. The researchers hypothesized that his pill-taking attributions prevented him from accepting responsibility for successful achievement in school. The authors again implemented placebo treatment while the teacher began attribution training using behavioral techniques and cognitive procedures. The teacher modeled, prompted, and reinforced the boy for making adaptive, internal attributions regarding the causes of his behavior. After two weeks, the teacher offered withdrawal of placebo as a reinforcer for the boy, and he quickly "earned his way off the pills." His teacher continued to encourage him to make internal attributions for his successes, and he continued to complete much of his assigned work and remain on-task most of the time.

Because, in the initial phases of the study, the boy's performance improved with placebo and deteriorated when placebo was withdrawn, the authors surmised that the boy's behavior was controlled by his dysfunctional attributions rather than by the active components of his medication. Their hypothesis was supported by the fact that the boy's behavior did not deteriorate when they withdrew placebo following attribution training. They concluded that there are compelling reasons to examine the influence of attributions and expectancies on the efficacy of drug treatment for hyperactivity.

Rosenbaum, A., O'Leary, K.D., & Jacob, R.G. (1975). Behavioral intervention with hyperactive children: Group consequences as a supplement to individual contingencies. *Behavior Therapy, 6,* 315-323.

Rosenbaum, O'Leary, and Jacob compared the efficacy of token reinforcement using group and individual rewards with hyperactive children. Subjects were 10 boys, ages 8 to 12, who were recommended for the study by their elementary school teachers and screened by the researchers for hyperactivity. The boys' regular classroom teachers implemented token reinforcement programs in which the boys earned reward cards, to be traded for candy, for displaying target behaviors individually identified for each boy. The individual-reward condition involved private contracts between each target child's regular teacher and the child. In the group-reward condition, teachers instructed each target child's classmates to ignore the boy's problem behavior and praise his good behavior. Thereby, the entire group earned candy based on the number of cards the target child earned.

Both treatments significantly improved ratings of hyperactivity and problem behaviors, with no significant difference in the effectiveness of the two treatments. Additionally, during a 1-month treatment withdrawal, both treatment groups maintained decreases in

hyperactive behavior. Although individual and group reward proved to be equally effective, the teachers rated group reward as preferable.

The researchers concluded that behavioral intervention, like drug-related therapy, can significantly improve the problem behaviors of hyperactive children. Because behavioral intervention can be ineffectual if it is not implemented consistently and correctly, the authors conjectured that classroom token reinforcement programs utilizing group reward, due to their popularity with teachers, may in practice prove more effective than those using individual reward.

Satterfield, J.H., Satterfield, B.T., & Schell, A.M. (1987). Therapeutic interventions to prevent delinquency in hyperactive boys. *Journal of the American Academy of Child and Adolescent Psychiatry, 26*, 56-64.

Satterfield, Satterfield, and Schell studied 186 hyperactive boys in order to determine the long-term outcome of drug-only treatment versus multimodality treatment for hyperactivity. The first cohort of 116 boys entered therapy in the period between 1970 and 1972 when they were between the ages of 6 and 12. These subjects received only drug treatment therapy. The second cohort of 70 boys, also between the ages of 6 and 12, began multimodality treatment between 1973 and 1974. A multidisciplinary team of therapists decided on the individual therapy approach for each subject receiving multimodality treatment. Multimodality treatments included medication; psychotherapy; and behavioral, behavioral-cognitive, family, and educational therapies.

When the subjects were approximately 17 years old, the researchers obtained the official arrest records for 81 of the drug-only subjects and 50 of the multimodality treatment subjects. (Statistical analyses of the two groups indicated that any comparisons between them were valid despite the subject attrition.) The researchers found no difference between the two treatment groups on the number of minor offenses committed (e.g. alcohol intoxication, possession of less than one ounce of marijuana, vandalism, or petty theft). They did, however, find that the mean number of felony arrests per subject was much higher in the subjects who received only drug treatment than in the subjects who received multimodality treatment. Similarly, the percentage of drug-only subjects who had been institutionalized was much greater than the percentage of multimodality treatment subjects who had been institutionalized.

Within the multimodality treatment group, when the researchers used length of treatment as a basis of comparison, they found that subjects who had received treatment for 2 to 3 years showed a much more favorable outcome than subjects who received less than 2 years of treatment. In fact, while outcomes for subjects who received less than 2 years of multimodality treatment were better than outcomes for subjects who received the drug-only treatment, the difference was not significant. The group that received 2 to 3 years of multimodality treatment showed significantly better outcomes than either the drug-only treatment group or the less-than-2-year multimodality treatment group. The researchers

conjectured that the long-term effectiveness of the combination of drug treatment plus multimodality treatment may be due to the interaction, rather than the simple additive effects, of the two treatments.

Shouse, M.N., & Lubar, J.F. (1979). Operant conditioning of EEG rhythms and Ritalin in the treatment of hyperkinesis. *Biofeedback and Self-Regulation, 4,* 299-312.

Research on brain waves has associated a certain cortex pattern, "sensorimotor rhythm" (SMR), with motor inhibition in humans as well as other animals. Shouse and Lubar studied the therapeutic value of SMR training for children with hyperactivity. They selected 4 subjects (gender and age not reported) who were diagnosed with hyperkinesis, had severe classroom conduct problems, and, on screening tests, displayed a significant deficiency in SMR production. Using a single-subject design, they investigated the effects of six treatment conditions combining methylphenidate therapy and SMR training. The researchers provided treatment sequentially in the following order: no-drug baseline, drug-only baseline, drug and SMR training-I, drug and SMR training-reversal, drug and SMR training-II, and no-drug SMR training phase. The SMR training, which employed an operant conditioning model, provided subjects with feedback on, and rewards for, SMR bursts (six cycles of SMR occurring within .5 seconds) measured by electroencephalograph (EEG).

The researchers assessed outcomes through laboratory measures of SMR production and through classroom observations of three categories of behavior: desirable (sustained attention, schoolwork), undesirable (self-stimulation, object play, out-of-seat, self-talk, opposition, noninteraction), and social (self-initiated and sustained interactions with peers or teachers). All subjects increased SMR production under the methylphenidate-only condition prior to the first training phase. Three of the 4 subjects continued to increase SMR production during the training phases. The fourth subject, whose SMR production was highest at baseline, failed to respond to the training after 64 sessions and was dropped from the study. The three successfully trained subjects continued training for totals of 140 to 170 sessions. Training effects for the successfully trained subjects generalized to the classroom setting as reflected by positive changes in 8 of 13 behavioral measures, including all measures of overactivity and distractibility except self-talk. The four behaviors that did not change were social behaviors. Improvements in behavior with SMR training persisted during the no-drug training phase.

Shouse and Lubar concluded that, though their findings suggest that SMR training is a meaningful treatment for hyperkinesis, the results must be interpreted with qualifications because of the small number of highly selected subjects, the lack of training success for one subject, and the degree to which alternative strategies used in training may have influenced outcomes. They also suggested that other treatments, such as electromyographic (muscular tension) feedback and behavior therapy, may be more efficient than SMR training and drug therapy.

Shroyer, C., & Zentall, S.S. (1986). Effects of rate, nonrelevant information, and repetition on the listening comprehension of hyperactive children. *The Journal of Special Education, 20,* 231-239.

Shroyer and Zentall attempted to determine whether problems that hyperactive children experience as listeners occur in response to rate of auditory presentations or level of stimulation. Using stories as listening tasks, they varied rate while holding constant the amount of relevant information, and they varied stimulation at high presentation rates by presenting the stories twice or adding irrelevant information. Based on teacher rating scores for hyperkinesis, Shroyer and Zentall selected 27 boys and girls, ages 6 to 9, from 10 elementary classrooms. They identified 12 hyperactive children with high scores and, from the same classrooms, 15 nonhyperactive children with low scores. They randomly assigned the hyperactive and nonhyperactive children to four story conditions:

(1) Slow: a story presented at 100 words per minute (WPM). (Normal conversational rate is 150 WPM.) They included this condition as one in which delay may provide inadequate stimulation for hyperactive children, thereby eliciting inattentiveness, impulsivity, and restless behavior.

(2) Fast: a story presented at 200 WPM. They included this condition as one that may be sufficiently stimulating to ensure sustained attention by hyperactive children.

(3) Fast-Fast: a story presented twice at 200 WPM. They described this condition as repetitive and minimally stimulating, and predicted that hyperactive children would exhibit stimulation-seeking activity and off-task behavior, but not performance disruption.

(4) Fast-Plus-Adjectives: a story presented at 200 WPM with the number of words in the story doubled by adding adjectives. In this condition, the adjectives served as nonrelevant detailed descriptions. Shroyer and Zentall hypothesized that this nonrelevant stimulation would distract hyperactive children and disrupt performance.

The children listened to the stories through headphones. Shroyer and Zentall measured their listening comprehension performance, activity level, and off-task behavior. For the hyperactive children, there were significant differences in activity level and performance due to story condition. Their activity levels and off-task behavior were highest in the repetitive condition (Fast-Fast), and lowest in the Fast condition. Their rates of off-task behavior were also high in the Slow condition. Hyperactive children performed most poorly on comprehension questions in the Fast-Plus-Adjectives condition. They performed better in the other situations, scoring highest in the Slow condition. Shroyer and Zentall concluded that, for hyperactive children, presentation rate may not be as important as stimulus input type. They suggested that high activity level and poor performance are independent problems for hyperactive children, but both are affected by stimulus novelty. More specifically, minimally stimulating listening tasks elicit sensation-seeking activity, whereas overly detailed or descriptive listening tasks cause performance problems.

Strayhorn, J.M., & Weidman, C.S. (1989). Reduction of attention deficit and internalizing symptoms in preschoolers through parent-child interaction training. ***Journal of the American Academy of Child and Adolescent Psychiatry, 28,*** **888-896.**

Strayhorn and Weidman conducted a study of a family training program with 98 low-income parents of 105 preschool children with behavior problems. The mixed race (64% black, 30% white, 6% other) and mixed gender (56% female, 44% male) child sample included 40% whose caretakers endorsed 8 or more (out of 14) symptoms of ADHD on a parent questionnaire and 43% whose caretakers rated restlessness as a problem. Additionally, on a rating scale, teachers rated over half the sample as having problems on the items "restless," "squirmy," "poor concentration," and "inattentive." The researchers compensated parents for their participation.

Researchers randomly assigned families to an experimental group or a minimal-treatment control group. For the experimental group, the training program emphasized teaching parents to have fun with and to instruct their children (as contrasted with an emphasis on child compliance). Five research assistants, with cultural roots in the communities from which the subjects were drawn, provided the treatment in two stages. The first stage was largely didactic and consisted of instruction, role playing, and practice exercises. Topics included: expected preschooler behaviors, communicating approval, increasing child attention, effective reprimands, modeling, and nondirective conversation. Completion of this curriculum required 4 or 5 two-hour meetings. The second stage of treatment for the experimental group was a series of play sessions with parents and their children. During these sessions, each parent first observed as a research assistant modeled story reading and dramatic play with their child. Parents then led play sessions themselves while the research assistant monitored. The parents continued to have monitored sessions (averaging 6.8 per family), followed by exercises or further modeling, until they reached criterion on a checklist of desirable aspects. Parents in the control group received a brief intervention that consisted of viewing instructional videotapes and receiving a copy of a summary pamphlet.

The experimental intervention produced statistically significant improvements over the control treatment on 7 out of 15 outcome measures. (All significant differences favored the experimental group.) The largest positive effects were in the ratings of videotaped parent-child interactions and in parents' ratings of their children's behavior and of certain aspects of their own behavior. Results also indicated a significant relationship between improvement in parenting behaviors and improvement in child behavior. The experimental intervention, however, failed to show a significant effect on classroom behavior. The researchers noted that their decision to include all original subjects in their analyses (only 15 parents attended consistently enough to complete the entire training, and some did not attend any intervention sessions) resulted in a conservative estimate of the treatment effects. Strayhorn and Weidman concluded that their study supports parent training as one intervention demonstrated to be useful in reducing children's psychiatric symptoms.

Strayhorn, J.M., & Weidman, C.S. (1991). Follow-up one year after parent-child interaction training: Effects on behavior of preschool children. *Journal of the American Academy of Child and Adolescent Psychiatry, 30*, 138-143.

Strayhorn and Weidman presented the one-year follow-up results of a previous study that examined the effectiveness of parent training on the behavior of preschool children. For the initial study, they recruited low-income parents of children with behavioral or emotional problems. Thirty-nine percent of the children had significant symptoms of attention deficit disorder as indicated by caretaker endorsement of 8 or more symptoms of ADHD.

The researchers conducted a preintervention assessment and subsequently assigned 98 parents of 105 children to either an experimental or a control group. The parents in the control group watched two videotapes concerning the use of time-out procedures and positive reinforcement. These parents also received a booklet containing parenting suggestions. The experimental parents received the same information that the control parents received, but also participated in extensive interaction training that included role-playing, modeling of behavior, conversational skills, story reading, and dramatic play.

Results at the one-year follow-up indicated that teacher ratings of the experimental children's behavior evidenced much greater improvement than teacher ratings of the control children's behavior (teachers were blind as to which group children had been assigned). The researchers also found a strong correlation between improvement in parent behaviors and improvement in the children's classroom hyperactivity ratings. They noted that these results are different from the results found at the postintervention assessment; at that time, while the parents rated their children as improved, the improvements had not generalized to the classroom. Conversely, the results one year after the termination of interventions, indicated that the experimental children's classroom behavior had shown considerable improvement relative to the behavior of the controls. Strayhorn and Weidman suggested that the study needs replication because the results of this follow-up showed improvement in unexpected areas.

Sullivan, M.A., & O'Leary, S.G. (1990). Maintenance following reward and cost token programs. *Behavior Therapy, 21*, 139-149.

Sullivan and O'Leary employed a single-subject design to study the maintenance of effects following reward versus response-cost token programs. Subjects for this study were 10 children between the ages of 6 and 9 who were attending summer school for academic remediation of math and reading.

The teacher used only praise and reprimand to manage the subjects for the first 7 days of class. During this time, observers collected baseline data on the on-task and off-task behavior of the subjects. The first treatment occurred from day 8 to day 15. During this time, the teacher used either a reward system, in which subjects earned checks for on-task

behavior, or a response-cost system, in which subjects lost checks for off-task behavior. The teacher employed one system during reading and the other system during math. Observers again coded the on- or off-task behavior of the students. Fading occurred from day 15 to day 22 of the class. During this time, the teacher gradually decreased the number of times she scanned the subjects and offered feedback on their behavior. The teacher then reinstated the response-cost or token reward treatment from day 23 to day 25. The treatment during this period was the same as during the first treatment period, except that the conditions during math and reading were reversed. The teacher reinstituted the fading procedure during the last 5 days of class.

Results indicated that both programs were effective in producing immediate gains in the subjects' on-task behavior. Half of the subjects showed a difference in the maintenance of on-task behavior following the fading of the token reward versus the response-cost system. The subjects who scored higher on teacher ratings of hyperactivity and aggression tended to maintain better performance following the response-cost system as opposed to the token reward system. The authors speculated that the reason for this disparity among the subjects' responsiveness could be due to the tendency of hyperactive children to respond poorly to partial-reward conditions or due to hyperactive children's greater need for reward than nonhyperactive children.

Thurston, L.P. (1979). Comparison of the effects of parent training and of Ritalin in treating hyperactive children. ***International Journal of Mental Health, 8,*** 121-128.

Thurston investigated the efficacy of training parents to use behavioral techniques to control their children's hyperactivity. Her subjects were 18 boys and girls, ages 6 through 9, who were medically diagnosed as hyperactive. They were separated into three groups: drug therapy, parent training, or waiting list for parent training (no-treatment control). Parent training took place in the playroom of a psychology clinic where parents received training from a behavior therapist and practiced behavioral procedures with their children. Targets of the behavioral intervention were hyperactivity and each child's additional problem behaviors.

According to actometer measures, both methylphenidate and parent training resulted in a significant reduction in activity levels. Based on parent ratings of activity, parent training reduced activity levels significantly more than no treatment. Parent ratings of overall improvement showed parent training to be superior to both drug therapy and no treatment. Measures of impulsivity showed increases for the drug therapy and control groups and a slight decrease for parent training, although none of the data showed significance.

Thurston concluded that parent training is as effective as stimulant medication for treating hyperactivity and should be seriously considered as a viable alternative to drug therapy. With parent training, she added, deficits in parental skills can be addressed and environmental contingencies can be redesigned while avoiding the potential side effects and long-term effects of medication.

Varni, J.W., & Henker, B. (1979). A self-regulation approach to the treatment of three hyperactive boys. *Child Behavior Therapy, 1,* 171-192.

Varni and Henker trained 3 hyperactive boys in self-instruction, self-monitoring, and self-reinforcement as an attempt to teach them to control their behavior and perform academic tasks in the absence of direct adult supervision. The 3 boys ranged from ages 8 to 10 and had been medically diagnosed as hyperactive. During training, one of the boys also received 10 mg of dextroamphetamine daily.

The researchers trained the boys first in a clinic room and later in a classroom. In the clinic setting, the children received training in the three self-control techniques: self-verbalizations (while working with mazes, matching tasks, and programmed reading texts), self-monitoring (using a wrist counter and point system), and self-reinforcement (tracking academic performance and accumulating points, through self-monitoring, to exchange for self-selected reinforcers). After training in the clinic, to test generalization, treatment moved to the school setting where the researchers set up open classrooms with 12 children per class. There was no formal instruction, and children were free either to work on projects placed throughout the room or to play. To minimize adult control and increase probability of self-control, sessions were held with no adult directly involved with the children. The strategies learned in the clinic did not generalize to the school environment, and the researchers, therefore, reintroduced the self-reinforcement treatment. The boys increased academic output and decreased hyperactivity, but these effects were highly variable, with some sessions indistinguishable from baseline levels.

Overall, results indicated that the children performed well during self-instructional training sessions. After the introduction of self-monitoring procedures, there was a transitory period when there were no significant effects. The researchers noted that this finding is consistent with previous studies demonstrating diminished effects when self-monitoring is not accompanied by reinforcement. The combination of self-monitoring and self-reinforcement improved academic performance and decreased hyperactive behaviors. On average, all three boys increased their academic performance and decreased their hyperactive responding during the self-reinforcement phases in both settings. For the most part, however, the boys ceased self-control behaviors without adult supervision.

A finding that surprised the researchers was the boys' ability to delay gratification up to 3 weeks before earning enough points to exchange for reinforcers. They also noticed that occasionally the boys were distracted from their work but would return to complete it. They considered this phenomenon to be an important aspect of self-regulation by which brief distractions do not totally disrupt sustained attention. Significantly, during self-reinforcement, there was much variability in the children's academic performance and their levels of hyperactive behavior. Varni and Henker interpreted this as a clear indication that the children exercised choice in deciding whether or not to work on any given day.

Worland, J. (1976). Effects of positive and negative feedback on behavior control in hyperactive and normal boys. *Journal of Abnormal Child Psychology, 4*, 315-326.

Worland tested the hypothesis that hyperactive boys would be off-task more and make more errors under negative feedback than under positive feedback. He studied the performance of 16 hyperactive boys, ages 7 to 12, and compared their performance to 16 nonhyperactive children. The hyperactive subjects had been previously diagnosed and referred to the study by pediatricians, psychiatrists, or special schools. Additionally, to qualify for the hyperactive group, boys from regular classrooms had to be rated as hyperactive by their teachers, while boys in special schools or receiving residential treatment due to hyperactivity were accepted as hyperactive without additional ratings. Worland studied children individually, in a "mildly distracting room." Each child performed two tasks (symbol encoding and spelling correction) under three experimental conditions: no feedback, positive feedback (nickels dispensed by a mechanical device), and negative feedback (sound produced by a burglar alarm horn). Positive and negative consequences were contingent upon on- and off-task behavior.

Unlike the comparison group, the hyperactive group was on-task significantly more under negative feedback than the other two conditions, but negative feedback significantly increased their errors on the spelling correction task. They were off task more than comparison children in all conditions except negative feedback. The hyperactive children correctly completed significantly less work than the comparison children on the coding task, but they remained on task and performed as well as comparison children on the spelling correction task regardless of the type of feedback.

Worland was not able to confirm his original hypothesis, but instead concluded that while consistent negative feedback can reduce off-task behavior for children who are hyperactive, it can decrease their accuracy. Worland cautioned that those considering the use of punishment with hyperactive children should evaluate its modest advantage over reward in terms of its potentially harmful side effects. In interpreting the results, Worland noted that the study used punishment and positive feedback only to keep children on task, not to improve the quality of their responses, and rewarding children for only increasing their on-task behavior may not spontaneously improve their task performance.

Worland, J., North-Jones, M., & Stern, J.A. (1973). Performance and activity of hyperactive and normal boys as a function of distraction and reward. *Journal of Abnormal Child Psychology, 1*, 363-377.

Worland, North-Jones, and Stern hypothesized that the performance of hyperactive children would be more adversely affected by a distracting setting than would the performance of nonhyperactive children. The authors also contended that there would be an inverse relationship between activity level and performance and that the use of a reward in a distracting setting would improve performance. The experimental subjects were 25 boys, ages 7 to 11, who had each received a diagnosis of "hyperactive child syndrome." The

researchers used 25 boys matched for age, race, and social class as a nonhyperactive comparison group.

Researchers tested each boy individually on (a) the coding section of the WISC-R, (b) a tone differentiation task and, (c) a dot-to-dot task. The boys completed these tasks in both a distracting and a nondistracting room. Each boy also completed an additional coding task in the distracting room with a reward offered as reinforcement. An observer and an electrical motion recorder measured activity level during the tasks and during free time.

Although the results were not significantly different, the hyperactive subjects were more active than the nonhyperactive comparison subjects in every condition except the dot-to-dot task in the nondistracting condition. Hyperactive subjects coded fewer items than the nonhyperactive comparison subjects under all conditions. Both groups performed best on the coding task in the distracting-plus-reward condition. Additionally, the hyperactive subjects performed significantly better on the coding task in the nondistracting condition than in the distracting condition, while their performance on the dot-to-dot task was not affected by the distracting condition. The authors concluded that hyperactivity is responsive to changes in the environment but that motivation is a stronger influencer of behavior and performance than is distraction.

Zentall, S.S. (1985). Stimulus-control factors in search performance of hyperactive children. ***Journal of Learning Disabilities, 18***, 480-485.

Zentall compared hyperactive and nonhyperactive children's performances on a noncolored search task to their performances on a colored version of the same task. She also examined the effects of level of search (i.e., narrow or wide focus) on performance. Zentall predicted that hyperactive children would achieve more with color than without, and they would perform better on wide-focus than on narrow-focus search tasks because the narrow focus reduces access to stimulation. The subjects were 35 hyperactive boys and girls, ages 5 to 13, and 35 nonhyperactive comparison children. Subjects in the hyperactive group had been rated by their teachers as demonstrating activity and attentional problems, and were screened for hyperactivity by the author.

The study took place in a small, partitioned area of an empty classroom where one subject at a time performed a visual search task displayed on a color video monitor. All children received the low-stimulation condition with the task presented in gray and black. On the color version (high-stimulation condition), to half of the children, Zentall indicated which colors were position-relevant, thus reducing the breadth of search requirements (narrow focus). For the remaining children, she did not specify relevant color (wide focus).

In reporting the results, Zentall mainly contrasted the hyperactive subjects to the nonhyperactive comparisons rather than comparing the performance of the hyperactive subjects across conditions. Hyperactive children were less accurate than nonhyperactive children on the noncolored task. On the colored version, the hyperactive children made

more errors than comparison children only in the last third of the task and only during the narrow-focus condition. According to the author, the restricted focus effectively made the color condition less stimulating to the hyperactive children. Zentall concluded that color added to search-attentional tasks, especially during early task performance, normalizes the performance of hyperactive children. After children have adapted to task and color novelty, however, performance gains diminish more rapidly for hyperactive children than for nonhyperactive children, particularly when the task involves a narrow focus of attention.

Zentall, S.S. (1986). Effects of color stimulation on performance and activity of hyperactive and nonhyperactive children. *Journal of Educational Psychology, 78*, 159-165.

Zentall studied 66 hyperactive and 80 nonhyperactive comparison children in elementary school to determine the effects of added stimulation to vigilance and concept tasks. Zentall also proposed to determine whether adding stimulation early or late in the task would have an effect on task accuracy and activity levels. She used a modified random assignment method to assign each subject to one of three treatment conditions: low-stimulation, early high-stimulation, or delayed high-stimulation.

The vigilance task consisted of three trays of slides that each subject observed in rapid sequence. The subjects were to identify every instance in which the letter "A" appeared followed by an "X." In the low-stimulation condition, all stimuli presented were black and white. In the early high-stimulation condition, the first two-thirds of the testing was done with colored stimuli and the last third was done with black and white stimuli. In the delayed high-stimulation condition, the first third of the testing was done with black and white stimuli and the last two-thirds of the testing was done with colored stimuli. The concept task required that the subjects notify, by way of a response key, whenever two shapes (as opposed to one, three, or four) appeared on one of two screens. The low-stimulation condition consisted of all black and white slides. The early high-stimulation condition consisted of colored slides for the first half of the testing and black and white slides for the second half. The delayed high-stimulation began with black and white slides and finished with colored slides.

The results indicated that the activity level of the hyperactive, but not the nonhyperactive, children was significantly reduced during the delayed high-stimulation condition relative to either the early high-stimulation or the low-stimulation conditions for the concept task. For the vigilance task, the activity level of hyperactive subjects was also significantly different across conditions, but their activity level was lowest under the early rather than the delayed stimulation condition. The hyperactive subjects showed greater task accuracy in both the early and the delayed high-stimulation conditions as compared to the low-stimulation condition on the vigilance task, but showed no difference in performance across conditions for the concept task.

Zentall concluded that the findings have implications for classroom settings. The results of the vigilance task indicated that the requirement for sustained attention to minimally stimulating or rote tasks sets the occasion for hyperactivity. Color stimulation in rote tasks can make the performance of hyperactive children comparable to their nonhyperactive peers. Furthermore, in learning tasks, color should be added only after the child has identified the relevant cues from the available task stimuli. Stimulation added later may then help to sustain attention and preempt stimulation-seeking activity.

Zentall, S.S. (1989). Attentional cuing in spelling tasks for hyperactive and comparison regular classroom children. *The Journal of Special Education, 23,* 83-93.

Zentall added color to spelling-recognition tasks to determine the performance effects of relevant color stimulation and the effects of the timing of that stimulation. She studied 20 hyperactive and 26 nonhyperactive boys, grades 3 through 6. She selected subjects for the hyperactive group based on their high scores on measures of ADDH. She randomly assigned the subjects to two condition orders for four trials: color applied to relevant letters for the 1st two trials of a spelling-recognition task, with all black letters used in the last two trials; or all black letters for the 1st two trials with color added on the last two trials.

In a small experimental room, Zentall tested each child individually on two occasions: during a pre-assessment spelling session and an experimental session. She individualized the spelling-recognition test to make it demanding enough that the ability to focus attention to relevant stimulation would significantly affect performance. In the experimental sessions, a microcomputer presented a correctly spelled target word followed by a list of six words consisting of the target word and five common misspellings. Each child had to recognize the correctly spelled target words from the lists. In the color-added condition, difficult or irregular (nonphonetic) letters were colored.

Hyperactive children made fewer omission errors (failure to respond within 12 seconds) overall when presented first with all black letters than with color-highlighted letters presented first. According to Zentall, when initially presented with color-lettered words, hyperactive subjects responded so slowly that they omitted responses. These results are consistent with other Zentall studies that found that color reduces activity level for hyperactive children (but not for nonhyperactive children) and also slows the task responses of hyperactive children. In this study, hyperactive children significantly increased activity level from the first half of the experimental session to the second in both condition orders. Zentall attributed the increases to decreased novelty of the setting and task. Nevertheless, the hyperactive children outperformed the nonhyperactive comparison children when the black-letter trials preceded the color-letter trials.

Zentall concluded that color facilitates attention to detail for hyperactive children in a spelling-recognition task and may have similar effects with other tasks requiring search and selective attention. Because hyperactive subjects performed poorly with color added

early in the task, however, she surmised that attention to detail in an initial exposure to a difficult task may be counterproductive. Most importantly, hyperactive children outperformed nonhyperactive children when they initially practiced the task without color and color was added later to relevant letters. Zentall emphasized that such gains may be found only when the task requires learning and selective attention and only when the color is added to relevant task cues.

Zentall, S.S., & Dwyer, A.M. (1989). Color effects on the impulsivity and activity of hyperactive children. *Journal of School Psychology, 27,* 165-173.

Zentall and Dwyer studied the effects of a colored version versus a normal (black and white) version of the Matching Familiar Figures Test (MFFT), a common measure of impulsivity, on the performance of hyperactive and nonhyperactive children. The subjects were 12 hyperactive and 12 nonhyperactive second- and third-grade children selected for the study on the basis of high or normal scores on the hyperactivity index of a teacher rating scale. The two groups were statistically equivalent in age, achievement, vocabulary, and IQ. Half of the hyperactive and half of the nonhyperactive group completed the colored MFFT during the first testing while the remaining subjects completed the black-and-white MFFT. One month after the initial testing, the subjects took the other version of the test.

Measures of latency, total errors, total time needed to complete 10 items, and activity level indicated that the hyperactive subjects made more errors and took less time to complete the task, but were not quicker on their first responses or more active than the nonhyperactive comparison subjects. Hyperactive subjects were more active than the nonhyperactive subjects during the black-and-white condition, but not in the colored condition. Also, the hyperactive subjects took more time with the colored test than with the black-and-white test. The reverse was true for the nonhyperactive subjects. There were no significant differences between groups or between tasks for measures of error rate or latency. The authors concluded that their findings support the "optimal stimulation theory," which suggests that hyperactive children have a greater need for stimulation than do nonhyperactive children, and therefore, hyperactive children need added task stimulation that nonhyperactive children do not need.

Zentall, S.S., Falkenberg, S.D., & Smith, L.B. (1985). Effects of color stimulation and information on the copying performance of attention-problem adolescents. *Journal of Abnormal Child Psychology, 13,* 501-511.

To test her optimal stimulation theory, which predicts that added stimulation will benefit hyperactive children during tasks that involve considerable repetition and monotony (i.e., sustained-attention tasks), Zentall and her colleagues examined the effect of color stimulation on repetitive-copying tasks. The subjects were 16 adolescent boys, ages 14 to 18, who scored high on attentional problems on a teacher rating scale and who had poor

handwriting based on criteria from the Test of Written Language. The researchers compared the subjects' copying performance across multiple conditions of stimulation and information that included (a) low-stimulation--black letters on white paper; (b) high-stimulation--alternating lines of colored letters; (c) low-stimulation with information added--increased width of salient parts of black letters; and (d) high-stimulation with information added--increased width of salient parts of colored letters. The researchers also compared the performance of the subjects with attention problems to the performance of a comparison group of 16 subjects without attention problems.

On most of the copying tasks, the boys with attention problems performed significantly better with high than with low stimulation. The researchers attributed the lack of stimulation effect on some tasks to a wearing off of the novelty of color stimulation. The comparison subjects did not score differently on error measures under the two levels of stimulation, nor did they differ significantly from the attention-problem subjects in their performance. The researchers found no additional significant group differences in errors, productivity, or activity level across any conditions, including the information-added conditions. They concluded that, for adolescents with attention problems, the data do not support the use of emphasis on relevant detail in rote-copying tasks but do provide support for the use of added color stimulation to reduce errors.

Zentall, S.S., & Gohs, D.E. (1984). Hyperactive and comparison children's response to detailed vs. global cues in communication tasks. ***Learning Disability Quarterly, 7,*** 77-87.

Because attention to detail requires a person to focus and sustain attention, Zentall and Gohs hypothesized that the difficulties hyperactive children experience as receivers of verbally communicated information would occur in response to detailed rather than global information. Their subjects were 26 boys, ages 3 to 7, who were selected from four nursery through first-grade classes. Thirteen boys with high scores on a teacher rating scale made up the hyperactive group. Thirteen randomly selected low-scoring boys were in the comparison group.

In a small observation room, an experimenter worked with each of the boys individually. Intervention consisted of a series of training sessions and tasks (Pretraining, Animal Names, Signal Training, Animal Details, and Novel Forms) administered to both groups of boys. With the Pretraining and Animal Names trials, the experimenter, using familiar stimuli (animal pictures), taught subjects to perform tasks requiring that they identify pictures based solely on verbal cues from the experimenter. In Signal Training, the experimenter taught the boys to use a signal buzzer to request additional information (cues). In the next phase of trials, Animal Details, the experimenter gave each child detailed cues by naming specific animal features. Children used the buzzer signal to obtain additional cues. After children mastered this task with familiar stimuli, the experimenter introduced the final phase, Novel Forms, during which children had to correctly select abstract forms under one of two conditions. To aid in selection of each

form, half of the hyperactive boys and half of the comparison boys initially received a global cue (description of the whole abstract form as a real object). If a boy signalled for additional information, the experimenter gave detailed cues (description of parts of the abstract form). The other half of the subjects received cues in the reverse order. With this task, Zentall and Gohs intended to compare the subjects' performance when given global versus detailed cues, and to compare the frequency with which both types of cues elicited requests for further information.

The hyperactive group took significantly longer to complete tasks when initial information was detailed rather than global. Hyperactive subjects also requested significantly more cues when their initial cues were detailed. Also, like the comparison group, the hyperactive group required more time to respond when the first cues given were detailed as opposed to global. Zentall and Gohs concluded that hyperactive children may process information in classroom listening tasks more easily when that information is global rather than detailed. Because the hyperactive group performed poorly only when receiving detailed information, and because they appeared to find detailed cues insufficiently informative (thereby requesting additional cues), Zentall and Gohs inferred that their listening problems may be specific to detailed verbal information. They ruled out the possibility that the hyperactive children's poor performance was due to passivity or poor motivation because the children willingly and independently requested additional information to successfully complete tasks. They provided suggestions for helping young hyperactive children perform more successfully in the classroom. For example, when teaching tasks that require hyperactive children to listen carefully or follow instructions, teachers should present new tasks or stimuli in general terms rather than with great instructional detail.

Zentall, S.S., & Leib, S.L. (1985). Structured tasks: Effects on activity and performance of hyperactive and comparison children. ***Journal of Educational Research, 79,*** 91-95.

Zentall and Leib's purpose was to determine the effects of a high-structured task versus a low-structured task on the activity level of hyperactive children and a nonhyperactive comparison group. They speculated that added structure would highlight appropriate responses and lessen the need for self-stimulating activity. For the high-structured task, the children copied an art design, whereas for the low-structured task, the children created their own art design. Subjects were 15 boys, aged 8 to 12, who received high scores on a rating scale for hyperkinesis. Sixteen boys who scored within the normal range served as the comparison group.

Through random assignment, the researchers evenly divided both groups of boys into two treatment conditions: high-structure-first/low-structure-second, and low-structure-first/high-structure-second. In a school library, the boys attempted the intervention tasks. The tasks required that the boys either replicate a design (high structure) or create their own design (low structure) using black-and-white construction paper squares. Blind observers rated the boys on both the quantity of squares used and on the quality of the finished products.

Additionally, the researchers fitted the subjects with motion recorders in order to document activity level.

The experimental and comparison groups did not differ on measures of quality of product or quantity of squares used in either the low- or the high-structured art tasks. The researchers found that while there were no differences in activity level between the two groups under either treatment condition, both groups were considerably more active under the low-structured activity. The authors concluded that, in task-oriented settings, high-structured tasks are more likely to cause reduced activity level than low-structured tasks for both hyperactive and nonhyperactive boys.

Zentall, S.S., & Meyer, M.J. (1987). Self-regulation of stimulation for ADD-H children during reading and vigilance task performance. *Journal of Abnormal Child Psychology, 15,* 519-536.

Zentall and Meyer investigated whether motor responses added to rote tasks would reduce sensation-seeking activity and impulsive errors of children with hyperactivity. Their purpose was to determine if the excessive activity characteristic of hyperactive children could be channeled into constructive active responses. Subjects were 22 children, ages 6 to 12, attending two parochial schools and a special school for children with behavior disorders, whom the researchers identified as ADDH based on the activity, attention, and impulsivity subscales of behavior rating scales. The researchers also identified a comparison group of 25 children, from the same classrooms, who scored low on the behavior rating scales.

Two experimental tasks required (a) sustained auditory attention (similar to a classroom listening task) and (b) the reading of a series of single words (simple word recognition). Under the active-response condition, subjects had opportunities for motor responses. During the auditory attention task, subjects could view nonrelevant slides by pressing a slide advance button, and during the reading task, subjects held the stack of word cards and turned the cards over as they read aloud. Under the passive-response conditions, no slides were available during the auditory attention task, and the researcher held the word cards for the reading task.

Zentall and Meyer measured a variety of behavior and performance variables to determine the effects of the active- versus passive-response conditions on the hyperactive subjects and to compare their performance to that of the nonhyperactive subjects. As predicted, they found a number of areas where the hyperactive subjects performed significantly better under the active-response condition. For example, the hyperactive subjects vocalized, made noise for longer periods of time, and were more active in the passive-response condition than in the active-response condition of the auditory attention task. They also maintained postural positions longer in the active-response condition. For the reading tasks, the hyperactive subjects made significantly more commission errors in the passive-response condition than in the active-response condition. Other results, that were not

statistically significant, similarly suggested that the hyperactive children derived greater gains in the active-response condition. Overall results also suggested that, when compared to their nonhyperactive peers, the behavior and performance of hyperactive children was enhanced to a greater degree by the stimulation of active responding.

Zentall, S.S., & Shaw, J.H. (1980). Effects of classroom noise on performance and activity of second-grade hyperactive and control children. *Journal of Educational Psychology, 72*, 830-840.

In two experiments, Zentall and Shaw assessed the effect of different levels of classroom noise on the activity levels and performance of second-grade children who were identified as either hyperactive or nonhyperactive on the basis of hyperactivity scores on a teacher rating scale. For the first experiment, subjects were 24 hyperactive students and 24 comparison students from a middle-class suburban elementary school. Half of the subjects first experienced the high-noise condition (recorded free-time activity in a typical second-grade classroom, played over earphones) and then the low-noise condition (earphones disconnected from the recording), and half experienced the noise level treatments in the reverse order. Two weeks later, the researchers switched the order of noise exposure. An actometer placed on each child's nondominant wrist measured the level of activity. Additionally, the researchers measured performance based on the number of correct addition and subtraction problems completed in a 25-minute period. The hyperactive children demonstrated more activity and poorer performance during the high-noise condition compared to the low-noise condition.

The second experiment, 5 months later, involved 36 students from the original group and 4 new students (2 hyperactive and 2 nonhyperactive comparisons). The experiment took place in a regular second-grade classroom. Randomly assigned in groups of 8 and experiencing reversed orders of noise conditions, the students listened to either high noise (recorded free time played over loud speakers) or low noise (recorded work time played over loud speakers). Under the two conditions, students circled letters, in alphabetic order, on an array of 20 sets of letters. The dependent measures were (a) activity level measured by wrist actometers, (b) number of head turns (off-task), (c) number of correct letter sequences, (d) error rates, and (e) type of error (omission or commission). Hyperactive students were more active and off-task, performed less well, and had more errors of commission (circling incorrect letters) during the high-noise condition. Both the hyperactive and comparison groups, however, tended to improve performance with repeated exposure to the task regardless of the noise condition. Task difficulty and familiarity interacted with noise level to affect activity levels and performance. Hyperactive students did less well and were more active with high-noise levels and novel tasks, while they performed familiar tasks better and were less active with low-noise levels.

Concluding that high levels of classroom noise appear to exacerbate the problems hyperactive children face on tasks requiring auditory processing, Zentall and Shaw

speculated that the poor performance during high noise levels may have been related to task difficulty and that linguistic distractors may improve the performance of hyperactive children on familiar tasks (as was the case for the nonhyperactive subjects).

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